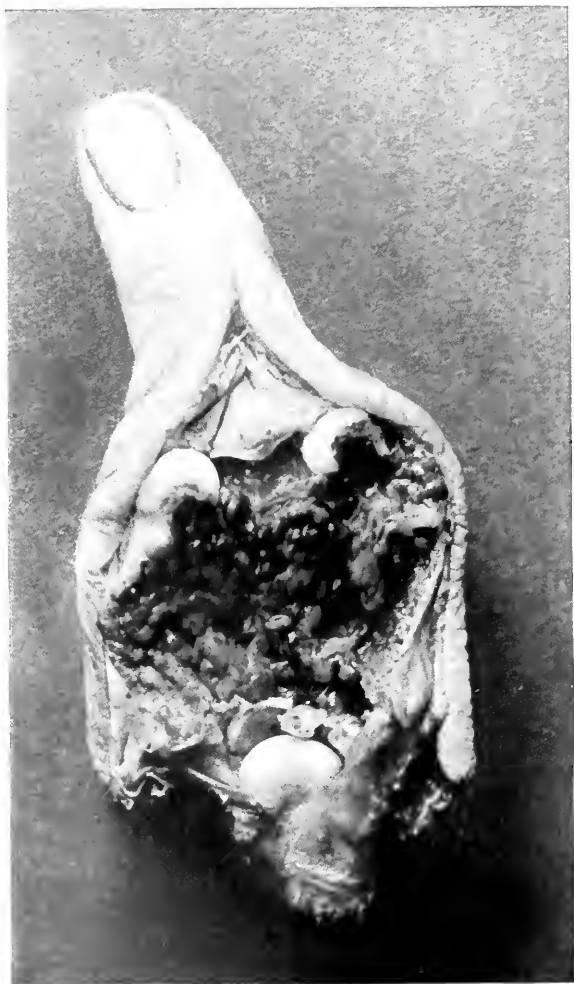




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FIG. 4.



Giant-celled sarcoma of finger.

[See page 214.]

A QUARTERLY
OF
ILLUSTRATED CLINICAL LECTURES AND
ESPECIALLY PREPARED ORIGINAL ARTICLES
ON
TREATMENT, MEDICINE, SURGERY, NEUROLOGY, PÆDIAT-
RICS, OBSTETRICS, GYNÆCOLOGY, ORTHOPÆDICS,
PATHOLOGY, DERMATOLOGY, OPHTHALMOLOGY,
OTOLOGY, RHINOLOGY, LARYNGOLOGY,
HYGIENE, AND OTHER TOPICS OF INTEREST
TO STUDENTS AND PRACTITIONERS

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Diagnosis and Treatment

THE THERAPEUTIC INDICATIONS FOR ANTITOXINS, SERUMS, AND VACCINES

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THE proper use of antitoxins, serums, and vaccines is a subject that is rapidly becoming of vital interest both to the specialist and to the general practitioner who are ambitious to apply for the relief of their patients the various reliable products of the modern laboratory, and the question will, therefore, be treated in a practical, applicable manner, care being taken to avoid as much as possible intricate laboratory methods, difficult nomenclature, and phylacogenetic discussion.

In recent years perhaps no branch of medicine has developed so rapidly or accomplished so much in the treating, diagnosing, and preventing of disease as that subject now designated as *Serum or Vaccine Therapy*, and it is perhaps not becoming too optimistic to predict that the time is not very far distant when every condition caused by a known infection will be treated, diagnosed, or prevented by the use of an antitoxin, serum, or bacterin, to the partial or complete exclusion of drugs formerly used for this purpose.

The success of antitoxins, serums, and bacterins, or vaccines, is due to the fact that their application and preparation are along rational, scientific lines, and the studies of phagocytosis in the presence of serum by Wright, Douglas, Denys, Leclef and Leischmann, together with the development of a definite, accurate means of measuring the degree of resistance of an individual to an infection by estimating the opsonic index, has opened up a tremendous field of laboratory study which is now rapidly crystallizing into valuable therapeutic application.

Broadly speaking, and for convenience, it may be stated that antitoxins, serums, or bacterins are used for prophylaxis, diagnosis, and treatment. The treatment may in turn be subdivided into conditions that are acute, subacute, or more or less chronic.

After making a diagnosis and deciding to use a serum or bacterin (vaccine) the question that naturally confronts the physician is, what quantity and what kind of a vaccine or serum shall be used? Unfortunately, the large majority of the profession, both in the city and rural districts, are handicapped at present by lack of laboratory facilities and by their inability to secure anything but "stock" (commercial) products, it being impossible to give an autogenous vaccine when it is indicated. This is indeed unfortunate, and it would seem that the time is at hand when it will be necessary for the profession to provide through local or central organizations some means by which those not located near or having access to hospital laboratories can be placed in a position to provide and administer these modern therapeutic measures.

When vaccines are indicated, autogenous preparations are by far the more reasonable, scientific, and successful in their effect upon a given condition, and should always be the first thought of by those who have laboratory facilities. On the other hand, it is almost imperative at the present time that "stock" vaccines be used in cases in which time is an important factor and immediate treatment is necessary, as in septic conditions and lobar pneumonia. In cases in which cultures cannot be obtained stock vaccines (commercial or private laboratory products) must be depended upon to make a diagnosis or to even continue the treatment until such time as an autogenous vaccine can be prepared. This is especially true at present of tuberculins, which are very difficult to prepare in the average private laboratory.

Much of the failure and adverse criticism of vaccine therapy, however, has been the result of the administration of cultures whose morphology has become so changed as to be practically valueless in everything but name so far as their ability to stimulate antibody production in a given case of infection is concerned. To illustrate, poor results are often secured from the injection of a gonococcic vaccine produced from a series of cultures extending over a period of several months or years into an individual suffering with an arthritis

or urethritis of comparatively recent origin; or the injection of an old pneumococcic culture into an individual with a fresh, active pneumococcic infection, when properly prepared vaccines would have accomplished the desired results.

Although the relationship existing between many of the active infectious organisms is very close—Andrews and Horder¹ even grouping the *Pneumococcus* with *Streptococci*—yet the difference, at least in therapeutic effect, is sufficient to be very noticeable in the results on the infection in the patient, *i.e.*, in pneumococcic infections complicated by the presence of streptococci it becomes necessary, if the best results are to be obtained, to mix the pneumococcic vaccine with a proper proportion of a streptococcic strain, and this in spite of the classifying of the *Pneumococcus* as a part of the streptococcic group.

Perhaps in no class of cases has serum and vaccine therapy been so successfully employed from the very beginning as in conditions where we find Staphylococci and Streptococci present as the predominant etiologic factors. These organisms, as is well known, are so prevalent that they either cause or complicate an overwhelming majority of the acute and chronic infectious conditions we are called upon to treat, hence their use, either alone or in combination, becomes a rather necessary part of the therapy. This is particularly true of such conditions as tuberculosis (pulmonary and bone), lobar pneumonia, bronchiectasis with infection, arthritis, old sinuses following operations for empyema, adenitis, carbuncles, furuncles, abscesses, acute otitis media, and many ophthalmological, gynecological, and genito-urinary conditions.

Whenever possible it is always necessary to open and freely to drain infected parts in order to relieve stasis, as a free healthy circulation to the part is essential to successful vaccine therapy. At the same time cultures can be taken and a careful study of the proportionate presence of the causative organisms made and a proper autogenous vaccine prepared. Stock vaccines can be used while the autogenous preparation is being cultured or be continued if found to be giving satisfactory results.

While the making of an opsonic index has been found not to be

¹ *Lancet*, September 15, 1906.

an absolute necessity, as was at first claimed, for the proper and safe administration of vaccines, abundant clinical study and careful observation are absolutely essential, and the physician, unless well acquainted as to the advantages and dangers of a given commercial product that he is about to use, should be very careful in accepting for use a vaccine or like preparation which may bear a very misleading label of "Guaranteed under the Pure Food and Drug Act," "U. S. Government License," etc., for it should be kept in mind that the Public Health Service at the present time only examines preparations as to the existence of living pathogenic organisms, the estimation of strength, and the presence of adulterations, and good work in this direction has given us very reliable diphtheria antitoxins, tetanus antitoxins and vaccine viruses. At the present time it would seem that it will be necessary for the Government to extend its field of observation to this broader field of preparations that are being produced and marketed in a more or less promiscuous manner. This might apply especially at present to tuberculin and antimeningococcic serum.²

In treating infections caused or complicated by *Staphylococci* or *Streptococci* vaccine administration has become almost a routine method of treatment.

BOILS, CARBUNCLES, FURUNCLES AND LOCAL ABSCESES

Here, as in all similar conditions, good free drainage and a free flow of blood and lymph to and through the part are essential to obtain prompt results. An early incision of the part, therefore, becomes necessary, followed by the application of compresses containing a hot solution of a one to two per cent. solution of sodium citrate as referred to by Wright, or a two to five per cent. solution of sodium chloride. At the time the incision is made, a smear or culture of the infection should be made and studied, and an autogenous vaccine made if autogenous treatment is to be given. As soon as the part has been opened and free drainage established, an injection of stock staphylococci should be administered, usually in the left arm about four inches above the elbow, and under strict aseptic conditions. As to the initial dose: in carbuncles of the usual size occurring in a patient with a

² *Jour. Am. Med. Assoc.*, January 1, 1912.

fairly good physical condition from 300 million to 1000 million staphylococci and 50 to 100 million streptococci can be given and repeated if necessary in a period of two or three days, depending upon the condition of the infection and the reaction, if any, on the part of the patient to the injection. The use of the vaccine will not only hasten the recovery, but will often prevent any reinfection in surrounding areas and discourage any tendency to chronic furunculosis, a condition which often occurs. Smaller injections can be given at intervals of two, three or four weeks with perfect safety as a prophylactic in chronic recurring cases and continued for from four to six months.

P. V. Szily³ has applied vaccine treatment to furunculosis in thirty infants from three to eight weeks of age without any bad effects and with a complete recovery in every case after eight to ten injections of *Staphylococci*. He made some variation in the preparation and technique, but the principle involved was the same as in all autogenous injections.

In treating old *sinuses* and *fistulas* the question of free drainage and nature of the infection throughout the long tract involved makes the results somewhat disappointing, especially in old sinuses following operation for empyema and fistula in ano. I have never felt, however, that my treatment of these conditions has been completed until I have made a careful study of the discharge and administered vaccines made up in etiologic proportions. In several instances I have been both surprised and gratified at the favorable results obtained.

ACNE VULGARIS

In *Acne Vulgaris* when one can keep the patient under proper control and observation a cure may be made in almost every instance, success depending upon the diagnosis, dosage, and time (intervals) of administration. The acne bacillus is in nearly every case accomplished by *Staphylococci*, in most cases the *Staphylococcus albus*. Dr. Orvall Smiley,⁴ of Indianapolis, found this to be the case in 86 per cent. of the cases he recently reported. Dr. H. A. Duncan,⁵ on the other hand, found that in the treatment of pustular acne a

³ *Wiener klin. Wochenschrift*, October 31, 1912.

⁴ *Jour. Am. Med. Assoc.*, April 27, 1912.

⁵ *New York Med. Jour.*, November 6, 1909.

vaccine of the *Staphylococcus citreus* gave better results. Personally, I still prefer at first a polyvalent staphylococcal vaccine mixed with acne bacillus, when possible to grow or obtain the latter. After cleansing the skin and applying warm saline solution at intervals for twenty-four to forty-eight hours and practising curettage, if necessary, an injection of from 100 million to 200 million *Staphylococci* mixed with acne bacilli (5 million), when obtainable, is given, and the dose gradually increased and repeated every two or three days until an improvement or a reaction is noticed, after which the dose and interval is governed by the condition of the patient and lesion. The bowels should be kept active with preferably a mild saline laxative taken daily and the use of alcohol, condiments, and tobacco prohibited; meats are to be taken sparingly, not more than once daily.

SEPTICÆMIA, PYÆMIA, AND ENDOCARDITIS

In these conditions variable results are experienced, the result depending upon the diagnosis, degree of resistance (opsonic index) of the patient, and one's ability to isolate a culture. Autogenous vaccines here give the best results if any at all are obtained. Ulcerative endocarditis caused by any of the common etiologic organisms (*Streptococcus*, *Staphylococcus*, *Pneumococcus*, or *Gonococcus*) has only been treated with a very limited degree of success. Improvement is often noted, but seldom becomes permanent. Thompson reported in 1909 seven cases of septic endocarditis with three cures, which he considered very remarkable.

Some striking isolated cures in cases of general septicæmia are reported from time to time, and when a culture is obtainable I always advise the use of a vaccine in these cases.

PUERPERAL INFECTION

In this condition I believe vaccine injections should form an essential part of the therapeutic treatment, especially when we consider the recognized high mortality resulting from uterine infection after delivery or during the puerperium. When possible an accurate bacteriologic diagnosis should be made and a blood culture with a two- to four-day incubation will usually make this possible, even when no culture from the uterus is made; the latter procedure, however, should never be neglected.

In the large majority of instances the infecting organism will be the *Streptococcus*, and in the minority of cases the *Staphylococcus* will be found, or a mixed colon infection. G. T. Western⁶ reports fifty-six cases of puerperal infection treated with vaccines of which thirty-eight lived and eighteen died, a mortality of 32 per cent. Of the forty-four patients he treated by other methods twenty lived and twenty-four died, giving a mortality of 55 per cent. In cases in which there is no fall of temperature after an appropriate trial with vaccines and the temperature remains stationary or shows a tendency to rise there is usually a walled-off pocket of pus present, which if found and opened will be followed by a positive phase and a prompt fall of the temperature to normal.

Dr. Duncan and myself⁷ were among those who gave vaccines an early trial in acute conditions, and among other cases we reported were some of streptococcic and staphylococcic infection. Upon reading our article Dr. B. C. Hirst applied vaccine treatment in a patient that he was treating at the time for puerperal infection, and in the last edition of his work on Obstetrics he says, "In one of my cases of severe and long-continued streptococcic infection which had resisted all other treatment an injection of two and a half million *Streptococci* was followed immediately by a permanent disappearance of all symptoms."

Antistreptococcic serum given simultaneously or alternately with streptococcic vaccines may be a valuable adjunct in the treatment, but the serum treatment alone at the present writing is not as effectual as vaccine injections, properly prepared autogenous being preferable. Stock vaccines can be used with a fair degree of success if the autogenous cannot be made. As in many other infections an early use of vaccines will often give the best results, but they should at least be considered as indicated in all stages of the infection. The dosage is, of course, variable, but an average of from 25 to 50 million *Streptococci* and from 200 million to 300 million of *Staphylococci* may be given, this to be repeated, increased or even doubled every two or three days, if necessary, depending upon the reaction and resistance of the patient.

⁶ *London Lancet*, February 10, 1912.

⁷ *New York Med. Jour.*, June 27, 1908.

ERYSIPELAS

The question as to the success in this condition of either vaccines or serum is one that is still a matter of debate. Some writers have reported improvement and others cures from the use of antistreptococcic serum (polyvalent) in marked and extensive erysipelatos inflammation. Personally I have had far more success with the use of vaccines in this condition, the favorable results often being surprising.

Ross⁸ reports fifty cases treated by vaccines and noted, as is usual in the less severe cases, an improvement within twenty-four hours. Ross used from 10 to 20 million *Streptococci* as an initial dose, depending upon the severity of the case. This was followed on the second day by another injection of 10 million; if no improvement followed smaller injections of five million were given. This he repeated every second day for a week, and then until the temperature and inflammatory area remained normal.

In 1908 Dr. Duncan and myself⁹ reported, in addition to two cases at an earlier date, three cases of marked erysipelas in which we used doses of from 30 to 60 million dead *Streptococci* with the most gratifying success. In one case affecting the face, after an injection of 50 million *Streptococci*, there was a fall of temperature twelve hours after the injection was given, although the inoculation was not made until the sixth day of the disease. From this time on the patient made an uneventful recovery. The second case was one in which there was marked swelling of the face and œdema of the eyelids. He was given his treatment on the third day of the disease, and on the morning of the following day his temperature was nearly normal and a marked improvement in his condition noted. He insisted on going home. The third case was one of erysipelas following a tonsillitis. There was marked swelling of the right lower eyelid, with a bullous eruption on the right side of the nose extending downward. The temperature was 104.2° F. Later the left lower lid became involved, and the inflammation spread to the ear and beneath the chin and with the opposite side passed completely around the neck and finally to the mammary regions and both arms. Tem-

⁸ *Jour. Am. Med. Assoc.*, March 6, 1909.

⁹ *New York Med. Jour.*, September 19, 1908.

perature was now 105.2° F. and the patient delirious. In the latter part of the second week an injection of *Streptococci* was given with some reaction on the following day and a remission of temperature, which finally became 99° F. on the third day and normal on the fourth day. There was no further extension of the inflammation, the patient making an uneventful recovery. Although I have met with an occasional failure, yet I feel that vaccines should play a part in the treatment of erysipelas.

SCARLET FEVER

In the absence of a knowledge of the definite etiologic organism in this disease the *Streptococcus* is looked upon by many as being at least in a large measure the causative infection, although the peculiar bodies described by Mallory (*Cyclaster scarlatinale*) should be kept in mind. Whether causative or not, *Streptococci* are certainly in almost constant association in this disease. With this fact before us many workers have used and made up many vaccines and serums, both for prophylaxis and treatment, but no decided definite results have been obtained and the treatment of this condition with anti-streptococcic serum and streptococcic vaccine in small increasing doses can only be considered as still in the experimental stage. The work of W. H. Watters, of Boston, Mass., in using streptococcic vaccines as a prophylactic measure to protect nurses from the infection is of great interest at this time and his success certainly merits further trial.

G. H. Weaver and R. Tunnicliff¹⁰ report six cases of erysipelas, two cases of scarlet fever, and two cases of chronic otitis following scarlet fever treated with antistreptococcic serum, in which all six cases of erysipelas terminated in recovery, a visible improvement being noted twenty-four hours after the serum was given. They showed with the improvement a concurrent increase of streptococcic opsonin above that observed in untreated cases. The serum given to the two cases of scarlet fever caused a rise in the opsonic index in each case, a fall of temperature, and a generally improved condition. Both patients were desperately sick, with an unfavorable outlook before the serum was administered, and both made a comparatively

¹⁰ *Journal of Infectious Diseases*, May 10, 1912.

rapid and complete recovery. The effect of the serum in the otitis cases was negative.

PNEUMOCOCCIC LOBAR PNEUMONIA

Although Osler in the eighth edition of his "Principles and Practice of Medicine" does not consider as satisfactory the results thus far obtained in the treatment of lobar pneumonia with serums and vaccines, the amount of work that is being done along this line at present by many clinicians and laboratory workers must ultimately result in an advance over the old method of treatment used to combat pulmonary pneumococcic infection. The field at the present time is divided into two schools or classes, viz., those working with and producing good results with vaccines and those doing likewise, but I think to a less degree, with serums.

From the results of his study of the action of immune serums on pneumococcus infections Wadsworth¹¹ says it is evident that immune serums vary greatly in their curative value. In the immunity produced by injections of dead culture material the strength was not sufficiently exalted for the serums to possess a practical curative value, it being only after immunization with virulent living cultures that the blood serum acquired marked curative action. After producing a pneumococcic infection in the rabbit, treatment with such a serum brought about a crisis and a cure in three animals. Wadsworth says that since the recovery of animals from pneumococcic infection differs in no essential from that of man, and since the unaided protective mechanism of man as compared with that of susceptible animals is exceptionally efficient, and as it is possible by treatment with serums from animals highly immunized with virulent living cultures of pneumococci to cure pneumococcic infections in the most susceptible animals, it is reasonable to conceive of the infection in man yielding similarly to the administration of such serums.

Pneumococcic and antipneumococcic serums have been given both clinical and laboratory trials by many workers from time to time with variable findings. At the 1912 annual meeting of the American Pædiatric Society Dr. Roland G. Freeman, of New York, reported his results in the use of serum in a series of cases, using

¹¹ *Journal Experimental Medicine*, July, 1912.

alternate cases as controls. The cases used showed high temperature with good physical signs. The serum was rapidly absorbed without any evidence of local irritation or general disturbance, but was followed by an urticaria. The injections were given to children of from eleven to twenty months of age. A general improvement was noted with no change in the physical signs. In most cases there appeared to be a better reaction on the part of the child, which was followed usually by some reduction in the leucocytosis and an increase in the polynuclear leucocytes. In treating pneumonia with pneumococcic serum in both adults and children large doses of the serum, 100 Cc. to 150 Cc., should be used and may be given with comparative safety. It may be given either subcutaneously or intravenously.

Vaccines have increased rapidly in their use as a means of treating and producing an early crisis in lobar pneumonia, and, after all, this, it seems to me, is the essential factor in treatment. The patient suffering from an intense and ever-increasing toxæmia which threatens from day to day to overwhelm his myocardium and kidney structure, or both, must be benefited by anything (be it a vaccine or a serum) that will lessen, counteract, or immunize such a toxæmia, if only to the extent of twenty-four hours; therefore this is a reasonable and rational treatment.

Rosenow has separated a large proportion of the toxic material from virulent *Pneumococci*, especially that part which goes into solution on autolysis, and believes that he has therefore remaining in the *Pneumococci* that part which stimulates antibody formation, and this more promptly and without producing a negative phase. He feels that the dosage of *Pneumococci* under these circumstances may be much larger and finds that after inoculation with this material the disease is much modified within forty-eight hours after the onset of an attack of lobar pneumonia, the temperature often falling within twenty-four to thirty-six hours, followed by prompt recovery. In a series of cases treated by Rosenow at the Cook County Hospital in which fifty patients were treated with his vaccine and fifty used as a control untreated, the mortality of the treated cases was 32 per cent., while in the untreated cases it was 50 per cent.

While I believe that the activity of any vaccine depends upon the quantity of bacterial endotoxin entering into the circulation and so stimulating antibody formation, yet, as before stated, I believe there

is a morphological factor to be considered, as organisms are not capable of producing a consistent (quantitative and qualitative) endotoxin at all stages of their development, so that old and new cultures do not bear the same relationship in respect to antibody stimulation in the human being.

The work done by Dr. J. O. Hirschfelder, of San Francisco, however, is a step in the right direction and should be the means eventually of helping to standardize the therapeutics. His object is to produce an active and passive immunity to the *Pneumococcus* with a soluble vaccine. He reports ten cases of pneumonia treated with an extract prepared from an emulsion of washed living *Pneumococci*. In the majority of cases there was a crisis within twenty-four hours after the giving of the first dose. There was a striking fall in the leucocytes within twelve hours and preceding the reduction in temperature. All of his cases recovered.

Nathan Raw¹² reports 207 routine cases of pneumonia treated by vaccines. The ages varied from 1 year to 70 years; 173 were cured and 34 died, a death rate of a little over 16 per cent. Symptomatic treatment was given as required. The average dose of the vaccine given was from 10 to 50 million *Pneumococci* to the adults. This was followed when necessary in twenty-four hours by an additional injection of 100 to 150 million organisms. Although Raw is not especially enthusiastic regarding the effect upon the crisis, yet he is convinced that the vaccine is not harmful and thinks that the injection of large doses is followed immediately, and that, too, very often, by a feeling of great relief, associated with a rapid fall of temperature and some improvement in the respiration, a good effect upon the pulse, and an absence of serious complications.

A rather disappointing view of this portion of the subject is noted in the report of F. Charteris¹³ in which he administered stock pneumococcic polyvalent vaccine in a series of nineteen cases of acute pneumonia. Ten additional cases that were apparently nearing a crisis were used as a control. The vaccine used was prepared from organisms isolated from the sputum of five typical cases of pneumonia and tried in variable doses in all stages of the disease. Four patients under treatment died of the disease and a fifth died of

¹² *Lancet*, March 9, 1912.

¹³ *Glasgow Med. Jour.*, January, 1912.

exhaustion on the sixth day after the crisis. The mortality compared not unfavorably with that occurring in the control cases. The only case in which the vaccine seemed to be fatal was in one in which death occurred from hyperpyrexia within eighteen hours after the injection of the vaccine. In another case the first two injections of the stock vaccine had no effect, but a third and a fourth injection of an autogenous strain were followed by a marked improvement. A fifth injection, however, was followed by alarming symptoms and the patient developed first an empyema and later meningitis. Charteris claims that the early administration of the vaccine did not abort the disease nor prevent complications, but that on the other hand the complications were relatively frequent in the vaccine series, viz., one developed meningitis, two empyema, and one hyperpyrexia.

In my own rather extensive use of vaccines in lobar pneumonia I would say that I have never had such unfortunate experiences as those reported by Charteris; in fact, my results have rather stimulated further and more extensive use of this treatment. In our service at the Samaritan Hospital, Philadelphia, Dr. Wm. Egbert Robertson and myself now make it a routine practice to give an injection of from 400 to 500 million stock *Pneumococci* in every case of lobar pneumonia just as soon as the diagnosis is made, and this is followed in two or three days by a second injection of the same size or a trifle smaller. Our results from the very beginning were so favorable when compared with control cases given the usual symptomatic treatment that we felt and feel now that we are not doing our full duty to our pneumonia cases unless they are given the benefit of vaccine treatment.

In a report of our first series of cases¹⁴ at the 1911 session of the Medical Society of the State of Pennsylvania we called attention to the high mortality existing in cases of pneumonia treated by ordinary methods, viz., the 991 cases of Ashton and Landis at the Philadelphia General Hospital from May 1, 1897, to October 1, 1904, in which there was a general mortality of 53 per cent., and those of Sears and Larabee, 949 cases, occurring in the Boston City Hospital from 1895 to 1900, the mortality rate being nearly 40 per cent. Norris reports a mortality of 47 per cent. in 445 cases treated by the fresh-

¹⁴ *Pennsylvania Med. Jour.*, January, 1912.

air method at the Philadelphia General Hospital. Craig¹⁵ states that practically all of the inmates of the Sailors' Snug Harbor Hospital are over sixty years of age and that the pneumonia mortality averages sixty per cent. In our own series of cases reported, of the 30 cases not given vaccines 12 died,—a mortality of 40 per cent. Of the 20 to whom injections were given 3 died,—a mortality of 15 per cent. If we exclude one case that died of uræmia the mortality of the 19 cases receiving vaccines would be 10.5 per cent.

Dr. Robertson and I find that the cases receiving vaccines seem to divide themselves into three distinct groups: first, those in which the injections are followed by a prompt fall of temperature to normal, accompanied by a rapid clearing up of the toxæmia and marked amelioration of all the toxic symptoms; second, those in which there is a prompt fall of temperature to or below normal (pseudocrisis), but in which a subsequent rise occurs, not quite as high as that previously existing, and this in turn followed by lysis to normal in twenty-four to forty-eight hours; third, those in which no appreciable favorable result occurs either as regards the temperature or toxæmia, the disease terminating by crisis in seven to nine days as usual. No complications occurred in any of the three classes of cases cited.

It should be remembered that consolidations of the lung may be caused by such organisms as the *Streptococcus* and the bacillus of Friedländer, or they may complicate a pneumococcic consolidation. In this case the pneumococcic vaccine must be proportionately mixed with these organisms if a favorable result is to be obtained. Failure to do this and make a proper study of cultures from the sputum may account for many of the cases in which unfortunate or negative results were obtained by some clinicians who have not met with the expected success of their treatment.

The *Pneumococcus* is an organism that is far more prevalent than is suspected by many physicians, and it is not uncommon to find it complicating or causing empyema, pleurisy, pericarditis, peritonitis, abscesses, genito-urinary conditions, otitis media, and conjunctivitis.

I have never noticed any marked favorable influence upon the

¹⁵ *Med. Record*, February 12, 1911.

clearing up of the physical signs in lobar pneumonia immediately following the crisis or termination of the toxic symptoms, but in cases of distinctly delayed resolution, especially when secondary toxic symptoms appear caused by a secondary infection or the result of a lighting up of an old previously existing infection, as tuberculosis, vaccines again become a therapeutic aid, especially when given with due regard for the etiologic organisms present.

TYPHOID FEVER

In this, at times, widespread infection the most brilliant results have been obtained in the field of prophylaxis. The continual and consistent success obtained in the English, German, and, later, American armies, in the use of this form of prophylaxis has put the question in such a favorable light that it would seem to be now the duty of every physician to thus properly protect the public not only from the so-called typhoid carriers, but also nurses and attendants in institutions caring for typhoid fever patients. In my own work in hospital wards in connection with Dr. Robertson we always employ and advise antityphoid inoculations in all resident physicians and nurses coming in contact with typhoid patients when the disease becomes prevalent.

A most excellent review of the subject of typhoid prophylaxis and vaccine preparation, which does not come within the province of this paper, is given by Dr. A. P. Hitchens in *Sajous' Analytic Cyclopedia of Practical Medicine*, vol. ii, pp. 308-317.

As to the therapeutics of this infection by the administration of serums and vaccines, much has been done and the question is being continually studied with the greatest care by both clinician and laboratory worker, but the results up to the present time are extremely variable.

In 1907 Dr. Duncan and I made a series of injections of vaccines in many typhoid fever cases, but were unable to abort or appreciably modify either the symptoms or the course of the disease. I have not been able up to the present time to feel that vaccines as at present prepared have any consistent favorable influence on the condition. I have never seen any harm caused by the injections, but fail to see any improvement in the many cases I have studied.

Chantemesse,¹⁶ in 1907, reported his own method of vaccine treatment of typhoid fever and he seems to have taken up the question from the standpoint of a serum. No one, however, reports such favorable results as he seems to have obtained in the Paris hospitals, by which the mortality was reduced from 17 per cent. under regular treatment to 4 per cent. under vaccine therapy.

Watters and Eaton¹⁷ reported a favorable influence on 75 per cent. of their cases treated with vaccines and a reduction of their case mortality from 11.1 per cent. to 3.2 per cent.

Sadler¹⁸ in over fifty cases treated by vaccine therapy found that an initial dose of one or two million killed bacilli, and followed by a smaller dose every four or five days, shortened the course and modified the severity of the disease. In my own work I use a dosage of from 5 million to 1000 million injected at intervals that seem to be of the greatest advantage to the phase of the disease. Callison also believes in large doses and gives an initial dose of 500 million, repeating the injections at intervals of four days, increasing the dose 100 million at each subsequent injection. In studying the statistics of 323 cases of typhoid fever treated by vaccine therapy he found a mortality of only 5.2 per cent.

In treating typhoid fever cases with vaccines, paratyphoid infections must be diagnosticated and other mixed active infections differentiated or negative results will surely follow the treatment. Paratyphoid fever is bacteriologically a separate and distinct disease from typhoid fever and as such the one dose not have any effect in conferring an immunity from the other, hence they must be treated with the appropriate vaccine.

It would seem that much of the failure experienced by many of us in treating typhoid infections is perhaps influenced by the fact that we use very largely non-sensitized bacilli. M. H. Gordon,¹⁹ from his experimental evidence on animals with the method of Besredka, finds his results to be very encouraging. Besredka regards the main action of sensitized vaccine as being to activate and accelerate the work of the leucocytes, and it appears to have some curative action in animals.

¹⁶ *Internat. Cong. of Hyg. and Demogr.*

¹⁷ *Boston Med. and Surg. Jour.*, 1909, and *Med. Record*, 1909.

¹⁸ *Quart. Jour. of Med.*, 1912.

¹⁹ *Quart. Jour. Med.*, London, July, 1912.

With this point in mind I am anxious to give the sensitized vaccines a trial clinically in typhoid fever by some such method as follows: On the admission of a typhoid fever case well advanced in the course of the disease, but showing clinically a good resistance (favorable opsonic index), to withdraw from this patient a quantity of blood and separate the serum, the same to be used in sensitizing, at a prolonged, moderate heat, killed typhoid bacilli, these in turn to be properly counted and used in increased dosage in second case of typhoid fever that may present itself. The difficulty that presents itself here clinically is the admission of cases at opportune times suitable for the extraction of a good serum and the presence and treating of another case.

CEREBROSPINAL MENINGITIS

In this field at the present time serum treatment is far in advance of vaccines and seems to promise more for the future than any other prophylactic or therapeutic measure thus far suggested. Some investigators have prepared standardized vaccines after Wright's method, using killed *Meningococci* suspended in normal saline solution and given injections to a few cases of meningitis with some success, the doses starting with 200 million and increasing to 1000 million.

The field of usefulness, however, will probably be more in the nature of prophylaxis, as in typhoid fever, and the serum left to the active treatment of the condition. Here the work of Flexner stands out as marking the most decided advance yet accomplished in treating meningitis, and reports of success are now of almost daily occurrence in medical literature. True, his methods and suggestions have undergone considerable modification, but to Flexner we owe the specific serum which has reversed the mortality and percentage of recoveries in this disease—one of the most striking advances in modern therapeutics.

The usual method of administration is by lumbar puncture, about 30 Cc. to 40 Cc. of antimeningitic serum being introduced, care being taken when making the puncture to withdraw at least as much fluid as you are expecting in serum to introduce. The fluid withdrawn is studied carefully as to its microscopic and macroscopic

appearance. If the symptoms are very severe, or increasing, the injection should be repeated within twelve hours; otherwise 30 Cc. of the serum is injected daily for a period of from four to five days unless the *Diplococci* are still present in the spinal fluid or there is an exacerbation in the symptoms, when the injections must be continued for a longer period.

I wish here to call attention to what is a very reasonable and helpful new method for controlling the administration of serum in epidemic meningitis as described by Abraham Sophian, of the New York City Research Laboratory of the Department of Health. Dr. Sophian has been using his method of administering intraspinally the antimeningitic serum for several months and believes it has now definitely proved its efficiency and superiority over the old method of administration. He says:

"The present method of standardizing the antimeningitic serum as generally accepted is by determining the opsonic index and by similar immune serum tests. There is, however, no measure of efficiency placed on the serum, such as we have in the case of diphtheria or tetanus antitoxin; the dose is, therefore, measured entirely by volume. Since the serum acts principally by its local action the idea was, and still is, to introduce as much serum as possible without injury. It was believed that after removal of a quantity of cerebrospinal fluid by lumbar puncture one could to a certain extent re-establish conditions in the central nervous system by injecting an equal or slightly smaller volume of serum. Thus in an ordinary moderately severe case in an adult if one withdrew 45 Cc. of cerebrospinal fluid an injection of 30 Cc. of serum would be safe and ample, while in a severe case one would be justified in injecting 45 Cc. or more of serum. It is seen by analyzing this method that one hopes and believes that conditions are re-established, but one has no proof. On this assumption many severe symptoms occurring either during or a few hours after an injection had been attributed to the disease proper. Undoubtedly toxæmia in some cases accounts for the symptoms; an analysis, however, of many cases would make one suspicious that possibly the symptoms in some were the direct result of the injection, especially when they occurred immediately during or after the operation.

"It occurred to me that if one could make determinations of the cerebrospinal fluid pressure during the operation one might so have a definite guide, the idea being to inject serum only in sufficient quantity to bring the cerebrospinal fluid pressure to the original reading before the removal of the fluid. In that way one would cause the least disturbance or shock. I, therefore, began to take cerebrospinal fluid pressure readings during the puncture. After withdrawing a quantity of fluid which reduced the pressure to normal I attempted to inject serum in sufficient quantity to raise the pressure to the original reading before the removal of fluid. Thus if the initial cerebrospinal fluid pressure reading was 400 mm. (water pressure) I removed the fluid until the pressure dropped

to normal or below, usually to between 20 to 100 mm. I then attempted to inject serum in sufficient quantity to raise the pressure to about 400 mm."

Without citing cases suffice it to say that Dr. Sophian found the results by this method to be very misleading and unreliable as indicating the true intracranial pressure. He could inject even larger quantities of serum than fluid withdrawn, but the pressure readings were frequently lower than the initial reading before the removal of the spinal fluid and even with readings showing a lower intracranial tension after the injection of the serum he would meet with some severe and dangerous symptoms. After making this careful study of the old method of estimating pressure Dr. Sophian took up the study of blood-pressure during lumbar puncture, especially with reference to the effect on injections of serum. To again quote from his article he says:

"I have now made blood-pressure readings in about 200 cases of meningitis, making from 500 to 700 lumbar punctures. I have found almost uniform results in blood-pressure change on injecting serum and have applied these changes as a guide to the quantity of serum that could be safely injected. The blood-pressure change was also frequently a guide indicating the quantity of fluid that could be withdrawn safely. My ordinary procedure in an adult case beginning with an average blood-pressure of 110 mm. of mercury is to stop the further withdrawal of fluid if there is a moderate drop in blood-pressure, for example, 10 mm. of mercury, and in children 5 mm. After withdrawal of a suitable quantity of cerebrospinal fluid the serum is ready to be warmed and injected. Reasoning by the old method of injecting serum one would expect a rise in blood-pressure. This, however, is rarely the case. In the great majority of cases when the injection of serum into the subarachnoid space is begun the blood-pressure drops and continues dropping steadily as the larger quantity of serum is injected. An assistant should take the blood-pressure readings throughout the whole operation. If the blood-pressure drops during the removal of cerebrospinal fluid I use it as a guide indicating when to stop withdrawing fluid. I accept as a rule the arbitrary drop of 10 mm. of mercury. I use the blood-pressure as an absolute guide indicating the quantity of serum I can safely inject. Here it is also a guide as to how quickly the serum may be injected. Since using this method I find that the average dose of serum has been considerably smaller; frequently not more than 15 Cc., averaging 20 to 25 Cc. in adults and in proportion in children."

Dr. Sophian's conclusions after a comparison of the old method and blood-pressure method, both of which I have given somewhat in detail, are as follows:

1. The old method of administering serum is inaccurate and sometimes dangerous.

2. Blood-pressure change is a very accurate guide to the quantity of serum that can be safely injected, frequently also indicating the quantity of cerebro-spinal fluid that can be withdrawn.

3. The average dose of serum as controlled by blood-pressure is smaller than by the old method.

4. Following an injection of serum, controlled by blood-pressure, the after-effects are usually much less severe.

5. Mortality figures . . . show unusually good results.

Dr. Charles C. Green, of Houston, Texas, at the 1912 meeting of the Southern Medical Association reported 182 cases of meningitis that occurred in Houston with 74 deaths, a mortality of 40.6 per cent., including those that were treated with and without the serum. Of the total number of cases treated twenty-nine did not have the serum. Twenty-one deaths out of this number gives a mortality of 72.4 per cent. Of the 153 cases treated with serum 53 died, or a mortality of 35.5 per cent., a reduction of 37.9 per cent. in favor of serotherapy. Dr. Green says that in taking the number of cases that had the serum treatment within twenty-four to thirty-six hours after the onset the death-rate was only a little over 20 per cent. He believes that if all the cases could have been treated by men who were familiar with the procedure the mortality would have been still lower.

In the *Archiv für Kinderheilkunde*, Stuttgart, October, 1912, Dr. E. Levy reports a case in which he obtained brilliant results by injecting 8 Cc. of antimeningococcic serum into the lateral ventricle, the route of puncture being through the fontanelle, with the child lying on the side of the head. He has done this operation on four children with a total of thirty punctures and fourteen injections without ever experiencing any permanent bad effects. Levy warns expressly against washing out the ventricle with salt solution and against injecting any more fluid than is withdrawn. He says that his experience confirms the tolerance of infants for injections into the lateral ventricles and that it may have life-saving value in otherwise hopeless cases, although the technique is not always easy.

The successful use of antimeningitic serum will depend upon first, an early diagnosis and then an early and proper administration of the remedy. Subject all suspicious cases to a lumbar puncture and examine, or have examined, the fluid for the *Meningococcus*.

Although the introduction of fluids into the spinal canal may be

attended with some danger, yet in cases with a positive diagnosis we should not hesitate to give repeated doses of the serum. It is now the recognized and proper therapeutic procedure in epidemic meningitis.

TETANUS

Except in the case of a few animal parasitic diseases, especially malaria and syphilis, recovery from an infectious disease depends upon the ability of the host to produce, through the activity of his body cells, substances called antibodies, excited and called forth by the invading agent, these antibodies possessing antidotal power inimical to the further growth and activity of the antigen, or infecting germ, and encompassing its destruction by specific bacteriolytic substances. Naturally success will depend on several factors, such as the degree of virulence of the infection, the ability of the individual to resist, or a combination of these. In the case of tetanus and diphtheria this statement must be modified to some extent, for the organisms causing these diseases produce a soluble toxin separate from the germ bodies, an exotoxin in contradistinction to the endotoxin of other germs, and the reactive substance or antitoxin is likewise soluble and extracellular and has no bacteriolytic action. In these diseases the antitoxin should be given sufficiently early, especially so in the case of tetanus, while the toxin is wholly free and circulating, not fixed by any groups of cells, and before severe secondary toxalbumic changes have arisen. Under these conditions recovery is assured, for it is merely a matter of neutralization of a poison.²⁰

Opinions differ as to the efficacy of serum in tetanus from the standpoint of treatment, but there is a general feeling that a certain amount of confidence should be placed in this therapy. As a prophylactic, antitetanic serum (500 to 1000 units) should be administered. Given early and in large doses the serum should be in treatment almost a specific, 1000 to 3000 units being given every three to four hours. As to the tolerance of patients to the serum, various total quantitative injections have been reported of from 100,000 to 200,000 units, and Dr. Frank van der Bogert, in the *American Medical Association Journal*, February, 1913, reports a patient under his care at the Ellis Hospital who received between April 26th and May 15th

²⁰ Robertson and Illman, *Penna. Med. Jour.*, January, 1912.

587,509 units of tetanus antitoxin obtained from the State Laboratory. This certainly showed at least a tolerance of the serum to an extreme degree. Dr. van der Bogert says, however, that two symptoms probably attributable to the serum were noted. The day on which the last injection was given the left hand became swollen and there appeared a mild urticaria. This rash and the temperature, which assumed an almost septic type, were attributed to the serum and treatment was discontinued. After a period of three days the temperature was normal and the patient convalescent.

DIPHTHERIA

The value of antitoxin in the prevention and treatment of diphtheria is and should be a universally recognized fact, and as years go on, the records of clinicians and institutions have shown that the use of antitoxin in diphtheria is, when properly administered, an efficacious and comparatively safe method of treatment. This success has had much to do with the small amount of work that has been done in the attempt to produce an active immunity with vaccines, but it is possible that eventually the use of these products in the treatment of diphtheria will prove to be successful. There is much that could be done in the field of prophylaxis and prevention of the spread of diphtheria by the use of vaccines with little or no danger, especially from "serum sickness," or anaphylaxis, a condition developing rarely in cases in which antitoxin has been given for prophylactic and treatment purposes. For the present so far as treatment is concerned vaccines may be used with some success in chronic conditions that are associated with diphtheria, as in diphtheritic rhinitis, and in persons in whom there is a suspicion as to their susceptibility to horse-serum, as in those affected with asthma. Hewlett and Nankivell at this opportune time have started to work with the preparation and injection of vaccines to help solve the problem of diphtheria carriers. They have produced a vaccine and injected five diphtheria patients while a membrane was still present in the throat, and in four cases no bacilli were present after a period of two weeks and one showed none after a month. In thirteen carriers injected with vaccines the bacteria disappeared in a short time. Work along this line done by others shows encouraging results, and the important question of

protecting our school children and others so exposed to chronic carriers may be on the verge of a solution.

Antitoxin has been in use over seventeen years and is employed by nearly every practitioner of medicine. The mortality figures of the civilized world prove its value. In England the death-rate in 1889 was 30.3, in 1894, 34.7, and in 1908, 16.6 per 100,000. In London the mortality has been reduced from 27 per cent. to 10 per cent.; in the Boston City Hospital from 70 per cent. to 35 per cent., and so all through American cities and institutions come these favorable endorsements and statistics.

In therapeutic application it is of the greatest importance to give the antitoxin early and in sufficient quantities from the very beginning of the treatment. Remember your success depends in using serum in this disease, upon the neutralization as soon as possible of a free and partly bound toxin. The initial dose should be at least 3000 to 5000 units and repeated until a favorable result is obtained. In laryngeal cases 5000 to 10,000 units should be given and repeated in from six to twelve hours, depending upon the progress of the case. It is far worse to make the error of giving too small a dose than too large a dose, especially if the infection is virulent from the very beginning in a marked degree. The injections are usually given subcutaneously in the scapular, thoracic, or mammary regions, or in the abdominal wall, with strict aseptic precautions. This method, of course, is the most convenient for the general practitioner and as far as anaphylaxis is concerned is the least dangerous; but absorption, it must be recognized, is very slow. Experimental work has demonstrated the fact that but a trace of antitoxin can be found in the blood of the patient four to five hours after the injection and only after 48 to 72 hours can larger amounts be found. When rapid effect and absorption is necessary Morgenroth recommends an intramuscular injection in the gluteal region, where absorption takes place much more rapidly. In an emergency intravenous injections have been given.

Five hundred to one thousand units is the usual prophylactic dose, given subcutaneously. Such protection lasts from two to four weeks. The question as to the value of concentrated and non-concentrated antitoxin is still debatable; a medium strength is perhaps the most efficient.

The one principal contraindication that exists at the present time, and always has existed since the introduction of serum and antitoxin therapy, is the production in the susceptible individual of that condition which has of late years been termed "serum sickness," or anaphylaxis. The production of this phenomenon in individuals who developed the condition in the past was never understood, and of late years the more we consider the subject the more our possibilities for good and bad results develop.

I do not for one moment want to discourage the use of antitoxins or serums, especially in diphtheria, but I am convinced that this condition (anaphylaxis) is produced to some degree in a great many more instances than we at present have the records of. It probably occurs in a majority of cases treated, but is unrecognized and not booked; the more marked, profound reactions being the only instances recorded because the death or overwhelming prostration fixes our attention on this or that unusual result. I believe that in many cases in which animal extracts, internal secretions, and glandular preparations have been given therapeutically without having been previously cleansed of the accompanying serum the unusual eruptive and respiratory phenomena produced may be explained on this basis of individual "hypersusceptibility."

This is undoubtedly true of the condition so often described as "protein fever," "protein poisoning," etc., in medical literature, which give a group of eruptive phenomena (urticaria) accompanied by fever, prostration, dyspnea, muscle pains and sweats.

In September, 1909, I reported ²¹ at the annual session of the Pennsylvania State Medical Society four cases of what I termed "Acute Accumulative Protein Poisoning" occurring in individuals who usually ate large quantities of meat, especially rare beef, and so absorbed and accumulated large quantities of animal serum. I said in closing that I believed the symptoms produced in the cases reported were the result of the stimulating effect of an excessive protein diet on the sympathetic nervous system. I am prepared to say now on the central nervous system as well. I think anaphylaxis is a condition that may develop gradually or suddenly, depending upon the manner and quantity of serum or meat juices absorbed. Besredka adheres

²¹ *Penn. Med. Jour.*, August, 1910.

to the view that the anaphylactic syndrome in some way injures or stimulates the central nervous system. He has shown that guinea pigs that were susceptible, after etherization, will bear perfectly well a second injection of serum.

It is to be remembered that in giving antitoxin or animal extracts it is not the antitoxin that produces anaphylaxis but the serum that is present, *i.e.*, the vehicle.

Dr. W. H. Park,²² of New York, in a very delightful, educational review of the subject of diphtheria written for the Bureau on Defence of Medical Research of the Council on Health and Public Instruction of the American Medical Association says of the subject of "Serum Sickness" as named by von Pirquet and Schick, "Only 20 per cent. of those cases injected with serum develop a rash and in many cases only a local reaction occurs. In a few cases the reaction occurs more quickly. An immediate general reaction is very rare. This immediate general reaction may be severe and alarming; in a very few instances it has been fatal."

I think Dr. Park's remarks here confirm my assertion regarding anaphylaxis, both as to frequency and degree of severity. Dr. Park further states, "The frequency of serum reactions increases somewhat with the size of the dose; thus Weaver reports that 11 per cent. of those receiving less than 10 Cc. of serum showed reactions, while 27 per cent. developed symptoms when between 10 and 20 Cc. were given. The serum of some horses is more apt to cause a rash than that of others; further, some people react more readily than others."

Some interesting observations have also been made in noting that serum from a horse of dark color is more apt to produce "serum reactions" when injected into humans of a light complexion, and *vice versa*. This observation is very likely merely a coincidence.

An interesting case of diphtheritic pseudotabetic paralysis with recovery under antitoxin is reported by B. Auché and Dantin in the *Journal de Médecine de Bordeaux*, October 13, 1912, in which a man 34 years of age developed diphtheria after the death of a child from the disease. After three injections of antitoxin he seemed to have quite recovered at the end of a week, but a few days later developed a paralysis closely resembling the motor disturbances of tabes. In the course of a month he was given 140 Cc. of antitoxin by subcu-

²² *Jour. Amer. Med. Assoc.*, February 17, 1912.

taneous injection and was entirely cured by the end of the second month. To avoid anaphylaxis when the second series of injections began test injections of 1 Cc. of the serum were first given.

Diphtheria antitoxin has been used for treatment in almost innumerable conditions, including the bronchitis of measles, S. Lieciardi reporting thirty cases in infants so treated with good effectual results. The beneficent effects in all such conditions are very likely the result of the serum and not the antitoxin. For this reason the antitoxin has given particularly brilliant results in the treatment and prevention of hemorrhage, even in some instances in hæmophilia. Several cases are on record in which the treatment of hemorrhage and hæmophilia has been successful when human serum was used and horse serum had proved of no value. Serum and tissue juices are at the present time the best means we have at hand in shortening the coagulation time of the blood.

As a final word on mortality and as to why we should use antitoxin in diphtheria I quote from Osler: "Of 183,256 cases treated in 150 cities previous to the serum period the mortality was 38.4 per cent. Since the introduction of serum, among 132,548 cases there was a mortality of 14.6 per cent.

TUBERCULOSIS

To describe the therapeutics of this condition in detail from the standpoint of serums and tuberculins would be quite beyond the limitations of this paper.

In diagnosis and treatment the use of tuberculin has become popular and more or less reliable and effective, recent years having witnessed a marked reversion of feeling, especially regarding its therapeutic value. The early disastrous results following the introduction of tuberculin by Koch in 1890 have, through the persistence of Trudeau and the investigations and study by Wright, been in many instances almost reversed, so that now we find tuberculin not only giving great satisfaction in so-called surgical or localized tuberculosis, but also finding a place in the treatment of the pulmonary lesions. Although tuberculin cannot be considered as a toxic product of the tubercle bacilli, yet it simulates these substances to a very close degree and creates to a certain extent a partial immunity to the products of the tubercle bacillus. Just what processes are involved

in combating the other products of this infection is not certain, but they are probably overcome (in cases of recovery) by the resistance of the individual infected.

There is a variety of preparations appearing under the name of tuberculin. O. T. and T. R. are Koch's old and new preparations. A bacillary emulsion of Koch, B. E., and bouillon filter of Deny's, B. F., are the ones most frequently used. After Koch differentiated between bovine and human tuberculosis there was an attempt made to immunize cattle with human tubercle bacilli. Spengler, from the opposite standpoint, used the milder bovine bacilli for tuberculin therapy in the human, and made up preparations similar to the old tuberculin and new tuberculin, the resulting reactions being thought to be less severe and the benefit to the patient as good or better than in the other tuberculins.

The technique and interpretations of the diagnostic reactions, viz., (1) Koch's subcutaneous, (2) von Pirquet's cutaneous, (3) Moro's ointment, cutaneous, and (4) Calmette's ophthalmic reactions, can be reviewed and studied in many of the modern works on this form of therapy and have been given in volume one of the twentieth series of the INTERNATIONAL CLINICS.

As to the therapeutics in tuberculosis of bones, joints, skin, eye, or glands, as well as in pulmonary tuberculosis, the entire field of diagnosis when preparing to give tuberculin must be studied carefully from the standpoint of bacteriologic etiology as well as the history of the individual and his habits and family history. In other words, unless you are prepared to select the proper medicinal and hygienic treatment, and know if there exists a mixed infection, you will meet with many disappointments. Fresh air, sunlight, good food and hygiene to develop a good index are even more essential when giving tuberculin; and in patients who show a low resistance clinically, or from a study of the opsonic index, it is far better to withhold all tuberculins or similar preparations until careful modern outdoor treatment has at least developed to some degree a positive phase. This is especially true of the pulmonary form of the disease, in which cases tuberculin must be administered with the greatest care and with due regard for the activity of the lesion at the time of treatment. I have never given tuberculin in acute miliary tuberculosis when diagnosed or in tuberculous meningitis.

Trudeau begins with very small doses that produce no reaction and gradually increases the dosage as indicated, but always avoids any reactive response in the patient. Others use very large doses and continue the same to the limit of tolerance.

I have found that good progressive results can often be obtained without increasing the dose of tuberculin, but giving repeatedly at intervals of 5 to 10 days a constant medium dose; as, for example, .001 milligramme of the T. R. preparation will be found to give a non-reactive clinical improvement and also consistently raise the tuberculo-opsonic index of the patient. I prefer the method of Trudeau to that of larger doses. I have given both large and small doses of tuberculin with improvement by both methods, but I do not think that the severe reaction that follows large dosage is at all necessary to obtain the best results, and, in fact, I have felt that at times, although there is a prompt fall of temperature and a better clinical picture after a large dose, that there has been a return of the condition later or the lighting up of an old dormant lesion whose activity had not entered into the first picture. Trudeau's beginning dose is 0.0001 mg. or as low as 0.00005 mg. of Koch's bacillin emulsion, or 0.001 mg. of the old tuberculin and increased gradually, producing little or no reaction. Wright employs a dilution of Koch's tuberculin T. R., equivalent to 0.001 mg. of the dry tuberculin, and this is increased to 0.06 mg.

GNOCOCCUS INFECTIONS AND ARTHRITIS

In this widespread infection and one that is an etiologic factor or complication in so many conditions we have a field of work that is almost inexhaustible. After a thorough trial by workers in all parts of the civilized world I think it can be said that for some reason not yet satisfactorily explained vaccine and serum therapy, except in isolated instances, has been a failure in both acute and chronic gonococcic infections in both the male and female. We do get undoubted good results in many instances, but I have never treated a case of either the acute or chronic phase of the disease that I have felt positively that the results were due to the vaccine used.

In old infections and lesions our failure is supposed to be due to the fact that *Gonococci* penetrate deeply into and between the cells of the deeper tissues and so become more or less walled off and protected, but if this be so why is it that even tremendous doses have

little or no effect on a fresh, recent acute urethritis? I think the only solution to the problem of treatment in this condition will be worked out strictly along the line of autogenous vaccines or serums, stock vaccines being almost valueless.

B. Slingenberg, of Treub's Clinic, Amsterdam, reports favorable results from polyvalent gonococcic vaccine injections in vulvovaginitis in girls and women with chronic affections of the ovaries and tubes. In some cases there were slight reactions and in others intense disagreeable reactions. He urges caution.

Dr. George W. Vandegrift,²³ of New York, describes a case of gonorrhœal choroiditis successfully treated by vaccines. The etiology of the case he reports is firmly established, not only by the therapeutic test but also by a positive complement fixation test made by Dr. Hans J. Schwartz. The examination of the expression from the prostate showed great numbers of *Gonococci* and *Staphylococci*. The patient was given, December 22, 1911, 100 million *Gonococci* and 125 million mixed *Staphylococci*. Increasing doses were repeated December 26th and 29th and January 2, 1912. Smaller doses were given on January 26th and February 1st. On May 15th the complement fixation test was negative. The patient of course received local treatment in the affected eye.

The local reaction that has been noticed by all who gave gonococcic injections for treatment purposes has now become of some importance for diagnostic purposes. At the point of injection of gonococcic vaccine in saline solution in positive cases, an area of erythema develops in the centre of which there is a small red papule of a deeper color than the area surrounding it.

In *acute arthritis* which is the result of absorption from a focus of infection good results are obtained by vaccines as far as the clearing up of the source of infection is concerned, provided it can be opened or locally treated, the arthritic phenomena usually clearing up with removal of the cause and the instituting of general eliminative treatment.

In treating rheumatoid arthritis (multiple arthritis) the report of T. J. Horder²⁴ on vaccine therapy in this condition is of interest. He follows the technique that should be pursued in all arthritic conditions caused by infections. He first investigates the case from

²³ *Jour. Amer. Med. Assoc.*, January 8, 1912.

²⁴ *Lancet*, London, April 20, 1912.

two standpoints: (1) a critical analysis of the symptoms and signs as referable to changes in joints, muscles, nerve tissues, blood, and general nutrition; (2) an examination which has for its special object the discovery of one or more foci of infection. He examines carefully the mouth, fauces, nose, nasopharynx, nasal sinuses, and respiratory and genito-urinary tracts. If a focus of infection is found, a careful culture and bacteriologic study of the infecting organisms is made, as well as their relationship to the arthritis. All foci of infection are kept freely drained and locally treated. If necessary septic teeth are extracted, an ulcer is excised or curetted, and an infected tonsil or polyp is removed. With the exception of two or three prophylactic injections all vaccine therapy is withheld by Horder for at least fourteen days after surgical measures have been undertaken on account of the likelihood of the patient inoculating himself, for this he says forms a contra-indication to the addition of fresh antigen or bacterial toxin while the temporary auto-inoculation is proceeding. Horder then proceeds carefully to treat his case by available means, as (1) immune sera, by which it may be possible to supply temporarily a degree of passive immunity; and (2) vaccines, by which he stimulates the patient to an active immunity. If no culture is obtainable in arthritic cases a polyvalent stock streptococcic vaccine can be used and if given carefully as to dosage no disagreeable results are apt to follow. A dose of from 25 to 50 million repeated at intervals of 3 to 4 days could be conveniently used.

A *Diplococcus rheumaticus*, *Micrococcus rheumaticus*, and *Streptococcus rheumaticus* have all been studied as the etiologic organisms, but it is more likely that the causative organisms are as variable in type as the arthritic phenomena themselves. Many arthritic symptoms and changes are probably not due to an infection, although the thought of the present day is running rapidly toward the infectious theory in nearly all so-called "rheumatisms." It is very likely, however, that true "rheumatism" with nephritic and endocardial involvement is an infection produced by some one of the streptococcic group.

PERTUSSIS

The treatment by vaccines of this obstinate infection is only in the experimental stage, but reports so far seem to be universally in favor of continued efforts being made to abort this condition. Here

as in pneumonia the child suffers from a toxæmia; not, it is true, so quickly overwhelming in its effects, but nevertheless continuous in its systemic destruction, and anything that will shorten the course and so modify the sequelæ of this disease is again a work to be encouraged.

Since the isolation of the *Bacillus pertussis* in 1906 by Bordet and Gengou considerable work has been done in treating the disease with serums and vaccines, although the discoverers of the infection have not as yet taken any definite stand as to the efficiency of this form of treatment.

E. E. Graham²⁵ reports twenty-four cases treated with a vaccine prepared by growing the Bordet-Gengou bacillus. In 29 per cent. of the cases he saw no apparent benefit from the treatment, while in 71 per cent. the results were beneficial and warrant a more extensive trial of the vaccines.

M. Ladd²⁶ cites nine cases of typical whooping cough in infants and young children treated with vaccines at intervals varying from five days to two weeks in which no harmful symptoms, local reactions, or bad effects were noted. The doses were from 3 million to 40 million organisms, one child being only seven weeks of age. Ladd says that in another series of cases he would use much larger doses at five-day intervals, or oftener. No other treatment was given and usually after three injections there was a decrease in the severity and number of the paroxysms. All of the cases recovered without complications, on an average in five weeks after starting treatment.

J. Zahorsky, of St. Louis, considers vaccines in pertussis in doses of 30 to 50 million to be a very helpful therapeutic measure. I think larger doses regularly given at three- to five-day intervals will give us in the future better results, providing of course that we keep in mind the possibility of the secondary and complicating presence of other active organisms that abound in the respiratory tract.

DISEASES OF THE EYE AND EAR

In treating diseases of the eye with serums or vaccines it must be remembered that antibodies and bacteriolytic substances are in some

²⁵ *Amer. Jour. Dis. Children*, January 3, 1912.

²⁶ *Arch. of Pediatrics*, August, 1912.

instances only brought in contact with the lesion in limited quantities, the cause for this being very largely anatomical. The cornea and vitreous receive only a very limited lymph supply and have practically no blood-vessels. The iris, on the other hand, having a good blood supply can be more easily treated, and the results in treating tuberculosis of this tissue are good. In treating the fundus the treatment must be prolonged and the results are questionable.

C. W. G. Bryan²⁷ gives a most instructive review of this question. He finds that the *Pneumococcus* and, next, the *Staphylococcus* are the most frequent infecting organisms, the *Staphylococcus aureus* being the cause of many varieties of chronic and recurrent diseases of the lids, blepharitis being caused by such an infection associated with a refractive error, and that such diseases can be cured by doses of 100 to 1000 million of the organisms. In chalazions and hordeola which occur frequently in some patients a cure may be effected by a three months' course of treatment.

In acute gonococcal conjunctivitis Bryan says that if vaccines be given early, before the internal parts of the eye are affected, giving small doses at frequent intervals, good results may be obtained with the vaccine. The eye, of course, should be kept clean and a free discharge looked upon as useful in carrying opsonins to the part.

Bryan has treated one case of Parinaud's conjunctivitis with *Staphylococcus albus* vaccine for some weeks with negative results. Cases of conjunctivitis due to the bacillus of Friedländer and the diplococcus of Morax have been benefited by vaccine treatments, as have also cases of staphylococcal ulceration of the cornea. He has had fair success when starting treatment early and giving, as soon as the diagnosis is made, 25 million polyvalent stock *Pneumococci* in acute ulcer of the cornea due to the *Pneumococcus*.

In diseases of the lachrymal sac due to pneumococcic infection of a more or less chronic type good results are obtained, but in acute infections with this organism or with the *Staphylococcus* the results with vaccines are disappointing.

OTITIS MEDIA

In applying vaccine and serum therapy to this important field of work many workers are reporting very encouraging results, although

²⁷ *British Med. Jour.*, March 23, 1912.

A. C. Christie (U. S. Army) believes the treatment should be confined to those cases which resist local treatment and when used should be an adjunct to such treatment.

In chronic cases the success of the treatment will depend upon the status of the mixture of the infection as to etiology, the condition of the circulation to the part and the amount of necrosis (if any) that is present.

In a very exhaustive study of 100 cases of otitis media following scarlet fever Weston and Kolmer ²⁸ conclude that the condition is one that may be treated with some success by vaccine therapy. They say, "According to our experience the best results were secured, considering all things, when cases were reported on the third day of the discharge." In culturing the organisms from the 100 cases they found—

In 14 cases, the *Staphylococcus aureus*.

In 2 cases, the *Staphylococcus albus*.

In 35 cases, the *Bacillus pseudodiphtheriæ*.

In 20 cases, the *Bacillus pyocyaneus*.

In 4 cases, the *Streptococcus pyogenes*.

In 9 cases, the *Staphylococcus aureus* and the *Bacillus pseudodiphtheriæ*.

In 4 cases, the *Streptococcus pyogenes* and the *Bacillus pseudodiphtheriæ*.

In 9 cases, the *Bacillus pyocyaneus* and the *Bacillus pseudodiphtheriæ*.

In 3 cases, the *Streptococcus pyogenes* and *Bacillus pyocyaneus*.

From this series of cultures can be seen at a glance the importance of cultural study before administering a vaccine.

In the report of five cases by Turner ²⁹ in which there was involvement of the sigmoid sinus or meninges, caused by *Streptococci*, three cases recovered. In the postmortem study of the two fatal cases it was shown that there was marked progress of the disease before the treatment was given and one of these cases showed an infection with the *Bacillus ærogenes*.

While it is true that the cases so far reported are too few in number to enable one to draw any positive conclusion, yet I feel that

²⁸ Jour. Amer. Med. Assoc., April 15, 1911.

²⁹ Jour. Laryngol., Rhinol. and Otol., 1912.

a proper culture study should be made early in every case of otitis media and vaccine therapy made a part of the therapeutics in conjunction with careful local treatment.

OTHER DISEASES

The field of application in the use of serums, antitoxins, and vaccines is constantly enlarging, and we find many reports of isolated success in a large variety of conditions, among which may be mentioned the following: influenza, hay fever, enteritis, cholecystitis, appendicitis, dysentery, peritonitis, pyelitis, cystitis, epididymitis, endometritis, pyosalpinx, chorea, carcinoma, lupus, anthrax, Asiatic cholera, bubonic plague, and Malta fever. Only those conditions in which some reasonable therapeutic indications exist at the present time, however, have been considered in this paper.

PRINCIPLES OF THERAPY UNDER MODERN BIOLOGY *

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DR. GALTON tells us in his "Memories" that, when he was sixteen years old, in the Birmingham General Hospital, he had at one time practically under his sole care no less than sixteen fractures, dislocations, or other injuries of the arm. A medical acquaintance of the speaker, in giving his professional history, said that at the age of sixteen he went to study with a country doctor. After four months his preceptor told him that he was prepared to enter practice on his own account, as he had learned well nigh all that his preceptor could teach him. Accordingly at the age of seventeen he "hung out his shingle," and he did well in practice. Thirty-five years ago it was customary for leading schools of medicine in this country to require only two years' attendance upon courses of lectures, each lasting four months, as the requirement for graduation. Contrast this with the four or five years now prescribed; and remember that to-day many schools are demanding a preliminary course of two years in a literary college, and that all exact at least a high-school education, whereas formerly there was practically no request for more than such rudimentary training as was given in the district school. Remember, further, that the school year is twice as long as formerly. Yet, owing to the tremendous advance made in the science of medicine, it is likely that the recent graduate, thirty-five years ago, was better qualified, as judged by the then state of the science, than is the graduate of to-day, when we consider the sum total of knowledge obtainable now.

Objection is sometimes made to the length of time now spent in medical education, but as the courses are arranged very many feel that too little is devoted to therapeutics, and the subject of preventive medicine is barely touched. Formerly all that was needed of the practitioner was a knowledge of the human body and its ail-

* Delivered before the Knox County, Illinois, Medical Society, April 17, 1913.

ments, with the gross action of drugs. To-day we realize that a knowledge of the human body requires a broad acquaintance with biology and zoölogy, as well as with many other branches of science. How many physicians know an *Anopheles* mosquito from a midge? Do general practitioners recognize the essential differences between the typhoid house-fly and the stable species which is being identified with infantile paralysis? Are they acquainted with the life history of the various disease-carriers among the members of the animal kingdom? Then, too, much light is shed upon human ailments by the study of the diseases of the lower animals. Nor must we forget that much of our recent great advance has depended upon non-medical men. Pasteur was a chemist, and the zoölogist Metchnikoff made his discovery of phagocytosis in his study of the nutrition of the amœba. To-day as never before, medicine is a learned profession. No other vocation demands such a breadth of culture.

What does all this mean to us who left our college halls decades ago? It means that the man who has not studied harder since he graduated than he did before has dropped behind. To use a slang expression, he has become "a back number," even though he may be more expert than he was in his earlier years of practice. There are too many commercial men in the profession, and too few physicians of the higher standard. It follows then that the legal requirements for entering the profession should be based, not upon the curriculum of the second-rate schools, but upon that of the best, and examinations for license should be strict. The object of education is to fit us to meet emergencies, not to cram the mind with facts and theories. The examination questions, therefore, should be calculated to show training rather than knowledge of unimportant points in anatomy or chemistry.

Every physician, as a part of his daily duty, should be a research worker. A knowledge of how to tackle a subject is more important than a knowledge of individual facts. This is a point well recognized by university men, but absolutely beyond the ken of the political license examiners who unfortunately compose some of the different state boards. Of what possible value, in determining the real qualifications of a candidate to practise medicine, can such a question be as that recently propounded by a certain board—"Describe minutely how a transverse section of a normal human appendix

would differ from a like section through the duodenum of a rabbit"? The same board also asked: "Show how alcohols are *derived* from water." By way of contrast permit a recital of the experience of a candidate for the degree of Doctor of Philosophy in one of our leading universities. His oral examination began with general questions, and constantly approached details; but the examiners did not particularly care whether or not he knew the minutiae. They were trying to determine how he would approach the subject, and whether he actually knew what he was claiming to know, or was "bluffing" at what he did not know. An incompetent man who spends a few days cramming with the aid of a collection of license questions may pass a text-book examination. Only the competent man may endure tests of training.

In the *Atlantic Monthly*, January, 1913, Mr. G. M. Stratton says: "Of two Rip Van Winkles awakening to-day, the physician would find his old methods as rust eaten and useless as his instruments; the lawyer, after a few hours with new statutes, would feel at home in any of our courts." Routine is a mental soporific which makes many men into Rip Van Winkles, only they never wake up.

How can the older graduate keep up with the advance in medical science? First, by reading leading medical journals and text-books. But this is not enough. He must pass frequent examinations in the subjects thus studied. These examinations are the natural result of attending medical societies, where in the mutual discussions he will correct erroneous conclusions and receive more light. Secondly, no medical practitioner can possibly afford to neglect frequent attendance upon medical societies. If he does, he will surely find within a few years (unless he is intellectually blind, or asleep) that he is dropping behind and taking his place in the rear end of the procession, among the stragglers. Nor is mere attendance at the meeting sufficient. He must be willing to betray ignorance by asking questions, and expose himself to the purifying fire of fraternal interchange of ideas. The man who writes a paper, on an average, learns thereby more than those who listen to its reading.

Sometimes it is possible for the practitioner to take a month or two at some medical college. If so, do not let the utilitarian idea of "the practical" take him too frequently to the clinic. He has been attending clinics all his years of practice. What he needs is to get

back to the fundamental sciences upon which his practice must be based. The laboratory is far more important for him than is the surgical amphitheatre.

Because of the simplicity of surgical art, its spectacular character, and the relatively greater compensation, surgery has received attention to the neglect of the far more important field of medical healing. In consequence there is too much uncertainty in the minds of medical practitioners. In answer to a question, a recent graduate from a leading medical school said that in pneumonia, for example, he was taught to try this, and, if it did not work, to try something else. This very uncertainty has passed from the minds of physicians, so-called, to those of their patients. It has become the subject of frequent jokes. Patients want something definite, not experimentation. In consequence, they listen to the positive, though often false, claims made by schismatics, quacks, and charlatans. We must not blame them. The fault is with ourselves.

Successful therapeutics must depend upon a clear idea of what is to be accomplished. This means that we must make a correct diagnosis, know the cause of disease, and how the cause works. Such a knowledge will point the way in which to look for a proper remedy, and tell us what we may hope to do, and what is apparently impossible. Cabot has recently shown,¹ by postmortems in the Massachusetts General Hospital, that in grave diseases there is a very large percentage of error in diagnosis. In general practice this percentage is undoubtedly very much greater. Such a fact calls for honest reflection in solitude by each of us.

MICROBIC CHARACTERISTICS

We find that a large proportion of diseases are caused by microbic organisms, either plant or animal. These microbes have various life histories, fairly constant for each species. Thus, some bacteria grow only in the absence of air, while others die in the absence of this same element. Some thrive only in acid media. Others cannot develop or live in the presence of acid. The fact, then, that a certain drug is bactericidal for one species does not by any means indicate that it is so for all. Using the term in its broad signification, as

¹ *Journal A. M. A.*, Dec. 28, 1912, p. 2295.

referring to bacteria and protozoa, it is unreasonable to expect that any one antiseptic will be equally efficient for all cases.

MECHANICAL EFFECTS

The fever of malaria is occasioned, apparently, by the mechanical shock produced when the matured protozoön explodes, setting free the newly-formed plasmodia. This is a direct effect of the germ of the disease. So, also, the mechanical injury to the red corpuscles of the blood may be charged to the direct effect of the organism, and, without considering any poison produced by the protozoön, we may thus account for much of the anæmia of malaria. Simply to combat the poison of the disease will not remove the distressing symptoms. The germ itself must be killed. Again: In membranous croup the diphtheria plant by its growth obstructs the larynx. The symptom is a direct result of the growth. Owing to the nature of the epithelium upon which it grows the plant may be easily displaced and produce complete occlusion. Because of the lack of circulation little poison can be absorbed. On the other hand, when the plant is located in the nose, with its free circulation, ample opportunity is offered for the absorption of the toxin. The mechanical obstruction is of very minor importance, and the symptoms are chiefly those of the poisoning. Here it is necessary to defend the system against the effect of the toxin. This we do by the administration of an antitoxin. If the antitoxin also acts as a bactericide, this is incidental. The mere holding in check of the destructive action of the toxin permits the ordinary defences of the body to attack the bacteria.

ENTRANCE OF GERMS TO CELLS

So far as we know, it is not possible for a bacterium to enter a healthy cell. It is possible that, after the cell wall may be broken down by the (chemical?) action of a toxin, a bacterium may enter the partially-ruined cavity, but such a broken shell offers also free access for other substances. In marked distinction from the foregoing, protozoa frequently enter the cells of the body, and are thus protected from harm while they are maturing their destructive schemes. It is practically useless to attempt, by the use of quinine,

the destruction of the hæmatozoön of malaria so long as it is fortified behind the walls of the red corpuscle. We make the attack when the newly-formed individuals are free in the blood plasma.

ENTRANCE TO BODY

Since bacteria cannot by their own power force themselves into healthy tissue, to gain entrance they must attach themselves to some friendly agent. Many enter the body with our food. Others take advantage of some bruise of membrane, or minute injury caused by previous disease. Not infrequently the bacteria may be carried from place to place by insects, and perhaps inserted by the hypodermic needle of a mosquito. In all these cases the insect is a simple carrier of the infection. The danger of infection decreases with the passage of time since the insect has come in contact with the diseased body or culture. The species of the carrier is not material, for the methods of propagation for bacteria are practically uniform.

CARRIERS VERSUS HOSTS

In the case of many protozoa, on the other hand, the insect may be more than a simple carrier. Take the sleeping-sickness of Africa, for example. This is due to a trypanosome which propagates asexually in the body of an infected patient to whom it has been communicated by a tsetse-fly. If such a fly bites a patient, he may be able to communicate the disease by biting another person within from twenty-four to forty-eight hours. During this period the fly acts as a simple carrier, just as is the flea a carrier of the bacillus pestis. After forty-eight hours the fly is incapable of communicating the disease for a period of about seventeen days, during which the protozoön is undergoing sexual reproduction in the body of the insect. Thereafter for two months the fly is again an infective agent. It has not been shown that any other insect, aside from the different species of the *Glossina*, can thus serve for the sexual development of the protozoön. In like manner the stegomyia mosquito is the only known intermediary host for yellow fever; the culex mosquito harbors filaria; and the various species of the anopheline mosquitoes alone permit the sexual cycle of development for malarial parasites. Any insect possessing the nature of a hypodermic needle, by extracting

blood laden with plasmodia and carrying it to a healthy person may be a disease carrier. Only special varieties may be intermediary hosts.

PROTOZOAL ENTRANCE TO THE BODY

It is not likely that bacteria upon healthy skin or mucous membranes may thus enter the body. A solution of continuity is necessary for the entrance of the germ. Not so in the case of some protozoa. Dourine, sometimes called horse syphilis, is a disease which is very fatal to horses. It was formerly supposed that it was always communicated through copulation. It is generally fatal to horses in from six months to a year. An epidemic among the horses and mules on the Canal Zone was carefully studied in the laboratory of the Sanitary Department, and the record of results may be found in different numbers of their monthly bulletin. Briefly, it was found that the trypanosome of the disease when placed on perfectly sound skin or mucous membrane enters the body and infects the animal. Flies (*Musca domestica*) are able to infect a healthy animal two hours after feeding upon a diseased nose. Since the *Musca* does not bite, this spread of the disease is due to the motile power of the trypanosome. Two mules in the Zone, which were inoculated with virus attenuated by passage through guinea-pigs, went through the disease to recovery, and the trypanosomes disappeared from the system. Subsequent inoculations, either with the attenuated virus or with a malignant strain, failed to infect the animals. These results, representing more than two years' investigation by the Zone laboratory, are at least encouraging. If, as seems probable, the *Spirochæte pallidum* is also protozoan, these observations as to the horse disease may be important relative to human syphilis.

ANTIPROTOZOAL TREATMENT

The foregoing indicates the more forcibly that treatment of protozoal diseases must be directed against the germ itself rather than against the poisons and their effects. In this regard an important lesson is taught by the African sleeping-sickness. This disease normally has a mortality of ninety per cent. or more. Atoxyl given in efficient doses kills the trypanosome in very many cases, and

this treatment results in over eighty per cent. of recoveries. Efficient treatment, then, lessens the possibility that new cases shall arise, for it lessens the possibility that the fly may imbibe the peculiar microbe. It is found, however, that if the drug be used in repeated small doses the trypanosomes become immune, not only to atoxyl but also to other arsenical compounds. This specific immunity is transmitted to subsequent generations of the germ, as tested through many successive generations. Unsuccessful treatment in these cases, therefore, seems to substitute a race of immune trypanosomes for those which are subject to treatment. What clearer demonstration is needed of the urgency for definiteness in therapeutics? We should *know* what we are doing or attempting to do.

BACTERIAL ANTAGONISMS

It is well known that milk, when left to itself, sometimes sours and remains sour for a long time before becoming putrid. Sometimes it putrefies rapidly after souring. At other times it becomes rancid without having previously developed the lactic acid to an appreciable degree. The souring may be due to any one of several organisms, among them being the different strains of lactic acid bacilli and yeast germs. The putrefaction is also due to bacteria. If the milk be inoculated with the lactic acid bacilli, especially with the Bulgarian strain, the multiplication of these bacilli occurs rapidly, and in such a presence the putrefactive bacteria are impotent. For this reason when sour milk or buttermilk is used medicinally it should always be thus artificially "started." When thus properly handled the milk attains a pure sourness without danger of rancidity.

Putrefaction is the result of the destructive action of certain bacteria upon proteid substances. Many of the products of putrefaction are distinctly poisonous to the animal body. Thus many of our common ailments are the result of such proteid destruction within the laboratory of the intestinal canal. We are all familiar with the sallow complexion, the dull headache, the disordered appetite, and the drowsiness which so often accompany the condition. Sometimes the disturbance is intensified, and we find vomiting and diarrhœa, fever, and possibly a prostration which ends in death. Knowing the bacterial origin of the disorder we may administer

antiseptics. Thus we may destroy many of the bacteria, but we are unable to kill all. Many of our drugs simply hinder the bacterial operations, without exterminating them. This drug medication, therefore, is like a housecleaning. The weak bacteria are killed, but the more resistant are left, and, having gotten rid of their weak brothers who were in the way, those who are left may more easily multiply as soon as the drug is withdrawn. The Bible tells of an evil spirit which when cast out wandered through dry places, and then returned to his former abode, which he found swept and garnished. He therefore found seven other spirits, more wicked than himself, and they entered in. The comment is that the last state of that man was worse than the first. This lesson may well be applied to the treatment of intestinal putrefaction by intestinal antiseptics alone. On the other hand, we may take advantage of the hostility between the lactic acid bacilli and the putrefactive bacteria. By administering buttermilk, artificially produced, we drive out the putrefactive germs, and in their place substitute those which are harmless.

[Putrefaction must not be confused with fermentation. Fermentation is a process by which carbohydrates are broken up. This is hindered by their normal digestion. Normally the digestion of starchy foods by the ptyalin admixed continues in the stomach for about half an hour after the meal, but the ptyalin cannot work in a distinctly acid medium. Buttermilk, taken with the meal, may thus hinder amylaceous digestion and favor fermentation.]

It does not seem reasonable to expect that the action of capsules or tablets containing dry bacteria will be as efficient as fresh cultures. In the dry stage many of the germs are probably in spore. It is claimed that the Bulgarian strain of lactic bacilli form no spores. It takes time for them to become active. When they start to grow they are relatively weak, and it would be possible for the putrefactive germs to prevent, or impede, the lactic development. Buttermilk is nutritive, and filled with active bacilli. Sometimes, when the taste of the sour milk is repulsive to the patient, the use of the tablet may be permitted.

A similar use of the lactic acid bacillus has long been tried in membranous croup, for example. It was formerly supposed that the dissolving action of the lactic acid upon the diphtheria plant was the

chief value. Now we know that in addition the lactic acid bacillus is antagonistic to the Klebs-Löffler bacillus. In a like manner a culture of the lactic acid is useful in that *bête noire* of dentists, pyorrhœa alveolaris. Berthelot has found also that the lactic acid bacillus is antagonistic, even *in vitro*, to the meningococcus. There are carriers of this disease as there are carriers of that of diphtheria. In all such cases a nasal spray of fresh lactic acid culture should be used effectively.

In a similar manner Professor Ravenel advises the use of a spray of a culture of staphylococci in diphtheria carriers. This seems to be efficient.

ANTISEPTICS VERSUS BACTERIAL THERAPY

The ordinary antiseptic is efficient in proportion to the size of the dose, and its action is very limited as to time. Moreover, the antiseptics may produce positive injury to the animal cells. The lesions which are thus produced favor the further harmful effects of the disease-producing microörganism. Further, the use of the antiseptic may hinder the natural defenders of the body. Hydrogen peroxide is an efficient antiseptic *in vitro*. In actual use it is often followed by an increase in the severity of the infection. I suspect that the reason for this is that the individual cells of the body take up so much oxygen that the normal phagocytic action is mechanically hindered. The swelling of other cells interferes also with the circulation, and the phagocytes cannot get into the battle. Swelling of the tissues may frequently be observed.

In the case of indolent ulcer hydrogen peroxide acts well to cleanse the surface, but it is common that the ultimate effect is disappointing. Yeast poultices have been despised as "old women's remedies," but in the light of modern biology we may possibly have greater respect for this kind of treatment. It is not impossible that the old-fashioned "bread-and-milk" poultice may owe its efficiency partly to the culture of the lactic acid bacillus which will most surely be produced. If that be so, why not use the culture intelligently?

Local infections, caused by bacteria which do not thrive in lactic acid media, would therefore yield to the local injections of cultures of the lactic bacilli.

ATTENUATED VIRUS

It has long been observed that one attack of certain diseases serves to prevent future similar illnesses. Taking advantage of this fact, our forefathers were accustomed to inoculate healthy persons with the germs of smallpox. Then came the discovery of Jenner, and the use of the cowpox germ, which is apparently an attenuation of that of smallpox. Thus we get a general rule in such cases that a person may be protected against a severe disease by inoculation with an attenuated virus. The attenuated virus is weaker in toxins, but active in producing phagocytosis. This protection may be attained even after infection and during incubation. How? Probably variola is a protozoal disease, so we shall use a protozoal illustration. In the asexual development of the malarial plasmodium each adult produces from six to twenty plastids. In the tertiary form each generation occupies two days in development. Ross estimates that an adult person weighing 142 pounds will not show malarial fever until such a time as 150,000,000 plastids are free in his blood at one time. He estimates that the plasmodium vivax increases at least tenfold in each generation. Taking the various powers of the different numbers, and multiplying by 1000, it will be seen that with a start of five plasmodia the fever stage would be reached in twelve days; that for six germs in ten days; that for ten in eight days; and that for fifteen in six days. These times we designate the "incubation period." Now applying this reasoning to the smallpox, we realize that a naturally-produced infection would not be likely to contain many germs at the start, and the incubation would naturally be long. On the other hand, vaccination would start with many germs, and the incubation period would consequently be very short. The production of immunity by vaccination would therefore be sufficiently rapid to probably head off the more severe disease. A similar reasoning would apply to the curative action of bacterins against their particular diseases, though because bacterins are dead, and incapable of multiplying, relatively larger doses must be injected.

The specific organism producing rabies is not known, but the disease is successfully treated by the use of a virus attenuated by drying. The spinal cord of a rabetic rabbit is dried, and the length of time consumed in drying determines its virulence. For the

first treatment it is customary to use a cord which has been dried for fourteen days in the dark at a temperature of 23° C. Every second or third day a stronger virus is injected, ending with a three-day virus. In this way the natural defences of the body are built up to meet the onslaught of the infection.

It is very unfortunate that the term "vaccine" has become commonly used with reference to distinctly differing principles. Its use should be strictly limited to inoculations with attenuated living germs, leaving the designation "bacterins" to describe inoculations with killed bacteria. This will serve to suggest to the mind the distinction in method of action between the two classes of products.

PHAGOCYTOSIS

The chief defence of the body against infection is found in the phagocytes. As a part of their normal nutrition these cells engulf and destroy proteid substances. When a phagocyte meets with a bacterium it surrounds and digests the germ, thus checking further danger from that individual. This phagocytic power is not limited, as many seem to think, to the white corpuscles found in the blood. It is common also in lymph-cells and the cells of the deeper structures of the skin, and of various glands. The phagocytic power varies in a given person from time to time and with regard to different bacteria. It may be active for the typhoid germ and weak for the streptococcus, or *vice versa*. Burnet says that quinine in 0.002 per cent. solution acts as a stimulant to the phagocytic power, but in 0.1 per cent. solution it depresses this action. Peptones are powerful stimulants, and iodoform also acts as a stimulant. On the other hand, the phagocytic power may be paralyzed by opium or by cold. This being so, the use of opium to control the pain of inflammation is contra-indicated. But it may be asked if the good results achieved by application of cold in local inflammations do not disprove the statement that cold paralyzes phagocytosis. Most bacteria do not develop well until a certain elevation of temperature is reached. Cold therefore retards bacterial development. The few bacteria which come in contact with the blood-plasma may be easily mastered by phagocytes which have not come under the influence of the cold. These few bacteria also stimulate the phagocytic power of

the system against that particular strain. The cold acts then by giving more time in which to build up the bodily resistance.

Bier's hyperæmic method consists in causing local increase of circulation, thus bringing more phagocytes to battle with the disease germs; and cupping has a like effect. To specially protect against infection in cases of abdominal operations many surgeons inject warmed blood-serum into the peritoneum.

VISCOSITY OF BLOOD

It frequently happens that in local inflammations there is an increase in the viscosity of the blood. This increased viscosity retards the circulation. In such cases the free use of citric acid or the citrates, which reduce the viscosity, tends to bring more leucocytes into the battle, and thus aids nature in combating the disease. Thus, in cases of a "brawny swelling," which is distinctly local, in boils and similar troubles, as well as in pneumonia, citric acid and the citrates are most valuable aids in treatment. On the other hand, in a septicæmia, where the bacteria are floating free in the blood-plasma, we should expect that this use of citric acid would be absolutely negative.

TOXINS AND ANTITOXINS

When a pathogenic bacterium is introduced into the body, and there begins to multiply, it also develops its peculiar poison or toxin. In the case of diphtheria bacilli this poison is excreted and readily soluble. The same is true of the toxin of tetanus, which shows a special affinity for nerve-cells. The toxin of the typhoid bacillus is not excreted, but it is set free by the destruction of the bacillary cell. Such poisons are called endotoxins. The toxins are not immediately poisonous to the tissues, in the same sense as strychnia is poisonous. Toxins resemble diastase in mode of action, and take time for incubation. As the toxins come in contact with the animal body specific antitoxins are produced. The phagocytes seem to be the chief, if not the only, source of these antitoxins. Apparently the antitoxin enters into a loose chemical union with the *free* toxin. If toxins and antitoxins, properly mixed, are introduced into the body together the effect is practically nil. If the administration of

the antitoxin precedes that of the toxin, the antibody is prepared to neutralize the toxin at once, and the effect is nil. This is the case in the ordinary prophylactic treatment. If the toxin has already made its union with body-cells the administration of the antitoxin will be without effect. This is well shown in the case of tetanus. The antitoxin does not draw the toxin away from the nerve-cells to which it has united. In actual practice, even though the nervous elements show the pernicious effects of the poison, we administer antitoxin to neutralize the free toxins which may still be produced.

DOSE OF ANTITOXIN

When a person is infected by a disease microbe he is not made immediately ill. The very few microbes first introduced must have time in which to multiply and produce their toxin. Remembering that bacteria propagate by division, and that the multiplication may occur once an hour under favorable circumstances, we may see that, without making allowance for destruction of any of the bacteria, one germ may become 160,000 within twenty-four hours. It would therefore take a very much smaller dose of antitoxin to neutralize the toxin produced by the original bacteria than it would after a few days. Five hundred units of diphtheria antitoxin is ordinarily sufficient for prophylaxis; 5000 should be regarded as a minimum dose used for curative purposes. Since the production of antitoxin begins soon after the toxin is excreted, the dose of antitoxin administered does not need to be exactly proportional to the number of bacteria. The disease approaches a crisis when there is an increasing quantity of free toxin; lysis begins when the antitoxin supply passes that of the toxin.

LOCATION FOR ANTITOXIN INJECTION

Since the antitoxin acts exclusively upon the *free* toxin, not only should it be introduced early, if it is to be used at all, but the location of its use is important. The injection of antitoxin starts a race between the antagonists. If the toxin reaches the susceptible cells and there works its injury, the administration of the antitoxin is relatively useless. Injections into the cellular tissue require much time for their absorption. From the peritoneum absorption is less

slow. Injections into the veins are much more efficient; but in such diseases as tetanus and meningitis even intravenous injections are too slow. It is the nervous centre which needs special protection in these maladies. Intravenous injections dissipate the antitoxin over the entire body. In the treatment of meningitis the injections must be into the lumbar spine. Tetanus antitoxin is more efficient when injected into the brain itself. Since this is hardly practicable in human cases we must be content with injections into the spinal fluid.

MANUFACTURE OF ANTITOXIN

Since the antitoxin has not been isolated for any disease, what we really mean in speaking of the preparations used medicinally is a serum, generally derived from the horse, and containing the antitoxin. The dose is reckoned according to its neutralizing power, and may be relatively very different from the bulk or weight, being standardized to a known unit of toxin. The investment required, the amount of time demanded, the facilities needed, all conspire to make it practically impossible for the private laboratory to prepare these antitoxic sera for ordinary use. The same is true of the various true vaccines. On the other hand, the high degree of scientific care requisite, and trust imposed, show that only the products of houses of well-known reliability should be used. Properly prepared, such medicinal agents must be relatively expensive. Cheapness is no recommendation for the product of any firm. Bacterins, on the other hand, may be prepared at moderate expense in any well-equipped biologic laboratory.

OPSONINS AND BACTERINS

Citron has shown that rabbits which had been inoculated with the extract from dead hog-cholera bacilli furnished a serum which was protective for guinea-pigs, though the bacilli would grow in that same serum. There are other examples of this same phenomenon. This indicates that an antitoxin is not of itself bactericidal. When, however, the killed bacteria are injected into the system, they arouse a reaction which shows itself in increased phagocytosis. Wright considers that this is due to a principle of the serum which prepares the bacteria for consumption by the phagocytes, and calls it an

opsonin. The followers of Metchnikoff do not deny that such a principle is found in the serum, but they think that they have demonstrated that it originates in the phagocytes themselves, and that it is simply a manifestation of the digestive power of those cells. They further affirm that it is a cell secretion, and therefore that it is only found in the serum after the cells have been injured. Be that as it may, this stimulation of phagocytosis is strictly specific. The power may be great for one bacterium but weak for another. Of course, when the killed bacteria are injected they are accompanied by their specific toxins. The immediate effect of the injection is an intensification of the symptoms of the disease. This is the stage of depression, which precedes the beneficial action. Living bacteria also stimulate the opsonic power. It is thus that vaccination with attenuated living germs acts as a prophylactic measure. In case of illness vaccination with unattenuated living germs would hardly be advisable in therapeutic practice. Neither would the injection of dead germs be advisable when there is a general bacteræmia—where the system is already overburdened with the effects of the toxins, and the phagocytes are unable to cope with the multitude of living germs. On the other hand, when the infection is local, and relatively few phagocytes have an opportunity to come in contact with the bacteria, we may find this bacterin treatment especially valuable. Thus, in a localized tuberculosis, as in the joint, or on the skin, or in corneal tuberculosis, the bacterin treatment may be very helpful. In a general tuberculosis it seldom helps, and often proves a serious detriment. Antistreptococcus serum apparently owes its efficiency to its opsonin content, not to antitoxin.

LOCATION FOR BACTERIAL INJECTIONS

It must be remembered that the *modus operandi* for bacterins is very different from that of antitoxins. With antitoxins we use a large dose to start with, and inject as close to the place where the toxin does its work as circumstances will allow. The bacterins produce their results by slowly coming in contact with the phagocytes. We therefore begin with small doses, and the place for injection is selected with reference to slow absorption. Since the phagocytes near the diseased area are already almost overwhelmed by living

bacteria, we find a place at a distance, to stimulate the general phagocytic power of the system. The subdermal cellular tissue of the back is a favorite place chosen, and the size of the dose is increased as the powers of the body are raised to withstand the effect of the dose.

BACTERINS SPECIFIC

Since this opsonic action is specific, it follows that there must be an exact bacterial diagnosis. If the disease be one which is definitely recognized, such as typhoid fever, a stock vaccine may properly be used. If the exact germ be not recognized, the bacterin used might better be prepared from cultures from the individual case.

There are many staphylococcus species, just as there are many varieties of diplococci. No one should think of treating a typical case of pneumonia with cultures of the diplococci of meningitis and gonorrhœa, but because of the diagnostic difficulty of determining streptococci and staphylococci in their exact species many are accustomed to take stock mixtures of different strains of bacterins. The result must be like firing a scattering load of shot from a gun. It may be that some of the shot may strike; it is quite as likely that none take effect. A good marksman uses a rifle rather than a shotgun.

An old doctor down in Indiana used to keep a large bottle in his office. Whenever any medicine was left from one of his prescriptions he poured it into this bottle. When he was in doubt as to what medicine to prescribe, he poured a phial full from this general receptacle. He remarked that he "got about as many cures from this as from anything which he used." Somewhat similarly a commercial house has recently put upon the market a mixture of the germs of many diseases. That this shotgun mixture sometimes hits the case cannot be doubted, but what is the use of putting fine bird-shot in with the bullets which are fired at a lion? Shotgun prescriptions always proclaim ignorance. They are like the mystified wanderings of the Babes in the Wood. This masquerading of indefiniteness under color of scientific progress should be emphatically condemned.

Let us now apply these general principles to a few specific ailments.

FURUNCULOSIS

In furunculosis we have to do chiefly with the multiplication, locally, of staphylococci. The toxin is not important, so that it is not worth while to bother with an antitoxin. We need to stimulate phagocytosis. This may be done by improving general conditions of circulation and nutrition. If specific treatment be required we should look to the opsonic influence of injections of dead bacteria. Since staphylococcus is a generic name, not specific, the exact bacterium which is involved may be a matter of question. We may, for convenience, use a stock vaccine made from several strains of staphylococci. If the result is not satisfactory it is no evidence against the value of bacterin therapy. We should use autogenous bacterins, made from cultures of the individual bacteria isolated in pure culture from the patient. Even here, because it might be possible that two species of staphylococci are growing side by side, one being pathogenic and the other not, it would be better to make the vaccine from a culture of a mixture of germs isolated at different times and by differing methods.

DIPHTHERIA, TREATMENT

It would be possible for a person to die from a disease with which he had not been infected. Infection only takes place when the specific microbe enters the body. An individual who was entirely free from the Klebs-Löffler bacillus would nevertheless die from diphtheria should a sufficient dose of the toxin be inoculated. The clinical picture of such a case would vary from a typical one chiefly by the absence of the plant. Practically the plant may be considered as outside of the body, or more correctly as "inter," not "intra." The great trouble is caused by the absorption of the toxin. The identity of the microorganism is definite. An injection of antitoxin is clearly indicated. Ordinarily the injection should be into the muscles; in urgent cases it should be intravenous. Since the growth is easily reached, we may aid in the destruction of the plant by sowing the seeds of another plant. Staphylococcus cultures may not be easily obtained when wanted. Lactic acid cultures are found everywhere. Since relatively few bacteria enter the system, phagocytosis may be practically ignored.

DIPHThERIA, PROPHYLAXIS

For diphtherial prophylaxis it has been customary to depend upon injections of antitoxin. Since horse serum is the vehicle for most antitoxins, and the protection of the antitoxin is not lasting, it may well be suspected that the susceptibility to anaphylaxis thus produced may outweigh the beneficent results. It is more than possible that the effect of the antitoxin may be to mask an infection. Because the toxin is robbed of its power, a weak growth of the bacilli might be permitted to go on undetected, and thus we may get our diphtheria carriers. It might be well, as a routine procedure, to use cultures of lactic bacilli sprayed into the nose and throat in every prophylactic case.

TYPHOID FEVER

In typhoid fever we have a very different condition with which to deal. Here we have a local infection in the intestines, where most of the bacteria are produced and the toxin manufactured. There is also a general bacteræmia. An antitoxic serum has not given satisfaction for prophylaxis, and its results in treatment may be questioned. A human serum, obtained from blisters on patients during lysis, has sometimes seemed to give good results. What is especially indicated in such a case is a limitation of bacterial development and stimulation of phagocytosis. For prophylaxis, as in the case of the army and navy, or for travelling men, where general hygienic conditions may be somewhat uncertain, repeated vaccinations with dead typhoid bacilli cultures give good protection, lasting perhaps about four years. In case of typhoid in the family such a measure is not necessary in the same sense as we find it possibly advisable to use diphtheria antitoxin. Typhoid prophylaxis in the family should depend upon general hygienic precautions.

Since the bacteria gain entrance to the body through the intestines, and since they do not flourish in acid media, the free use of acidulated drinks is a prophylactic and curative measure. Fresh milk, being an excellent culture medium for the typhoid bacilli, is contra-indicated, but buttermilk may be useful. A portion of the disturbance caused in this disease is probably due to the action of other putrefactive bacteria, and these cannot work in the presence

of an ample culture of the lactic bacillus. Since the typhoid bacteria are found freely circulating in the blood, and thus affording ample opportunity for phagocytosis, and since vaccination with dead bacilli also introduces the endotoxin, bacterin therapy may be of questionable propriety, especially at the height of the disease. If it be used, the opsonic index must be closely watched.

PNEUMONIA

In pneumonia we have essentially a local growth of bacteria, with a tendency toward stasis of blood. Much of the seriousness of the disease is due to the mechanical effect of the congestion, checking circulation, and aëration of the blood. Poisons which are normally eliminated through the lungs, or are destroyed by oxidation, remain to oppress the body. The most important indication here is to relieve the congestion by reducing the viscosity of the blood. This can be accomplished by the use of citric acid and the citrates. Secondly, we must stimulate the specific phagocytosis. This may be done with inoculations of dead cultures of the pneumococcus. Since the pneumococcus is frequently assisted in its diabolical work by the streptococcus or staphylococcus, it may be best to use those bacterins also. So far as I know, a successful antitoxin for pneumonia has not been produced, but even were it obtainable it must apparently be of minor importance to the bacterin.

DRUG MEDICATION

Finally, biologic products, though important in modern treatment of disease, by no means remove the necessity for the use of drugs. Symptoms must be relieved as they arise. Biologic remedies are expensive, and easily deteriorate. Often they may not readily be obtained. Not seldom equally good results may be secured by the use of simple medicaments intelligently prescribed. When ordered carelessly or according to an unreasoning routine, much harm may be done. Remember the words of Duclaux: "With Pasteur chemistry invaded the field of medicine, probably never to leave it." The therapeutic problems of the future are largely chemical: how to kill the protozoa without injury to the patient; to produce antitoxins outside of animal bodies; and, chiefly, the nu-

trition of the phagocytes, to render them still more efficient. We may not all do the original work, but we may and should keep informed as to the progress which is being made in our most noble science and art.

In conclusion, the tabulated statement here given will show at a glance the gist of the article:

GENERAL INDICATIONS

	Therapeusis	Prophylaxis
Protozoal diseases.....	Drug zoacides	Vaccination (?)
Bacteria producing {	Toxins ANTITOXIN	{ Antitoxin (?) Bacterin (?)
	Bacterial antagonists	Bacterial antagonists
	Endotoxins . { Bacterins Antitoxin (?) Opsonic sera (?)	Bacterins

ADMINISTRATION

Antitoxins.—Large initial dose, repeated in progressively smaller doses, *pro re nata*.

Vaccines.—Small dose, possibly repeated after all symptoms have disappeared.

Bacterins.—Small initial dose, followed by progressively increasing doses.

THERAPEUTICAL EXERCISES PERFORMED BEFORE A MIRROR

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THE purpose of this article is to call the attention to a method of conducting therapeutical exercises before a mirror, in which the muscle effort is directed with *mental concentration* on the act. This may be regarded as the highest type of active exercise. By therapeutical exercises we mean the use of exercises for the prevention or cure of disease and the correction of deformity.

It is recognized that by "muscular exercise" the functions of respiration, circulation, nutrition, and excretion are profoundly affected, and the heat-controlling mechanism of the skin and sweat-glands is stimulated to greater activity. Hence, in diseases of the various parts of the body, such exercises should be selected for function or organ as will tend to re-establish its normal relation in the economy.

If we regard the physiological entity of man to be made up of a muscular system, a neural system, and a life-giving function,—*i.e.*, lungs, heart, stomach, pancreas, liver, spleen, kidneys, intestines, etc., which require exercise to keep up their normal work,—we must recognize the effect of the change produced by the occupations of men and women, and the indoor life of women.

The method I am about to describe, and which I have followed for more than twenty years, is based on the following scientific facts.

It has been demonstrated by Anderson, of Yale, and others, that when a person is securely placed on a body balance and concentrates his mind on an extremity the hyperæmia thus produced tips the body balance in the direction of this limb.

It has been found, in the examination of the human brain, that when motion of an extremity is guided by mental concentration, the convolutions in the gray matter of the brain, presiding over this motor area, are increased. The reverse of this process has been frequently demonstrated: postmortem examination of the cerebral

FIG. 1.



Arm and leg paralysis, with muscle exercises before a mirror to develop the weaker group of muscles

FIG. 2.



Spinal curvature, with muscle exercises before a mirror: attention given to the development of the weaker muscles.

cortex of an individual minus an extremity from intra-uterine amputation demonstrates lack of development of the cortical centre for that area.

A moment's thought makes clear the fact that the nerve efficiency or nervous control as displayed by the gyrations of the Nautch dancer can be developed by any person in any set of muscles if a proper effort is made for development of sufficient nerve force and nerve control.

The stimulus transmitted from the brain to the periphery depends on the calibre of the conducting nerves, as the diameter of copper wire regulates the volume of electric current capable of transmission.

Hence, if we recall the varying diameters of the same nerve in different subjects dissected, we realize that the size of the nerve indicates the power of transmission, and this variation in size is similar to that of 00 catgut to No. 3.

We must now realize that the concentration of the mind on the muscular effort does not only initiate the movement, but determines blood to the controlling nerve-centres, producing growth and development in the conducting nerve filaments.

Now, were it possible to examine the conducting nerve in the beginning of our treatment and six months or a year after, we would possibly find as much difference as between size 00 catgut and No. 3, with a corresponding increase in sulci in the gray convolution of the brain.

It is well to entertain the fact that mental concentration has a most beneficial effect, whether in intellectual brain development accomplished by higher mathematics or by concentrated effort while gazing into a mirror. It is an accepted fact that the superiority of one mind over another is in the extent to which one can concentrate one's mind in a given effort for a given length of time.

The practical application of this method of treatment as applied to some conditions will be set forth in the following pages.

The treatment should be given before a large and well-lighted mirror, so that the patient can see all parts of his body clearly, and with nothing else in the range of vision to distract his attention.

In our private practice, either at the office or at the home of the patient, the patient should be treated individually, and no one ex-

cept the one giving the instruction and the patient should be present in the room. By this means we obtain the best result. However, in institutional work, where this cannot be done, the efficiency for concentration is rapidly developed, and children over three years of age are given instruction, six or more at the same time, without the child ceasing for a moment to observe his own work, and observe either the work of others or the presence of the visiting staff or strangers. This is done daily at the Hospital for Deformities and Joint Diseases, which has been visited by nearly all the leading neurologists and pediatricians of New York City, who have commented on the ability with which young children go through their concentrated efforts wholly unconscious of the presence of a stranger. (Figs. 1 and 2.)

The patient's whole attention must be concentrated on the exercise of the part under treatment, and, when possible, on the particular muscle or muscles involved. When the patient observes the action taking place in the mirror, and what his efforts are attaining in a few days' work, one is surprised at the excellent effort they will put forth to accomplish the suggested end.

There should be no clothing in use which will hamper the movements or obstruct the vision. In treating any of the extremities this is easily accomplished. In corrections of the body, particularly in lateral curvature, the back should be so reflected in the mirror, or with compound mirrors, that the patient can see the action of the erector spinæ and other muscles of the back, so as to work the muscles and accomplish the desired effect.

In the beginning light massage or beating of the muscles will aid their action. This is also further attained by approximating the origin and insertion of the muscle and increasing thereby the bulk of the muscle with the correspondingly increasing contracted force. The instructor must make clear to the patient what muscles are to be brought into use, thus concentrating the mind on the physical effort about to be made, and have the contraction made slowly under mental concentration for its effort and effect.

In the extremities, when, owing to a paralytic condition, the contracted force is not sufficient to move the limb, the instructor can aid in the desired motion, compelling the patient to make all mental effort toward its attainment. As the muscles become stronger, the

FIG. 3.



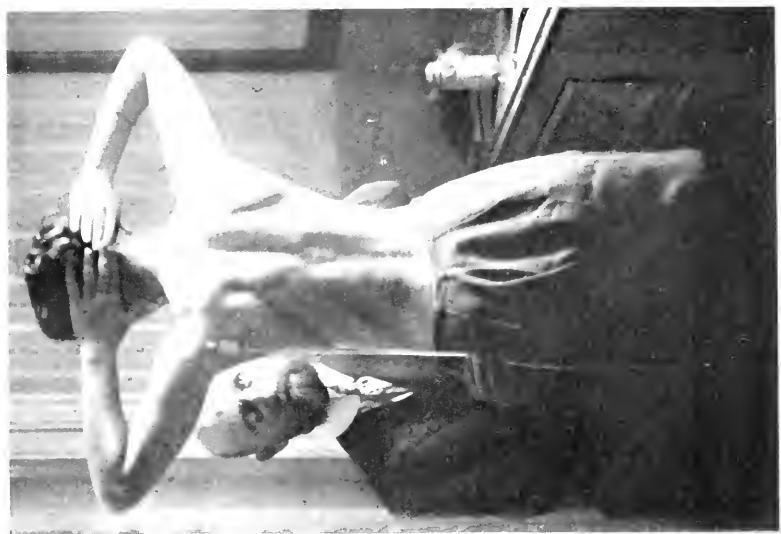
In the mirror to the right is seen foot placed at right angle to be brought up 30 degrees. In mirror to the left, observe instructor assistant's hand supporting foot and holding the leg fixed.

FIG. 4.



Plumb-line demonstration of muscle control. Note distance between body and plumb-line before muscular contraction.

FIG. 5.



Note approximation of body and plumb-line with contraction of muscle without movement of the body.

assisting force put forth by the instructor becomes less, so that the muscle is allowed to take up more of the work and run the whole of the exercise and receive the maximum amount of exercise possible to a muscle in its weakened condition.

The exercises should always stop short at the point of fatigue. This is most important, for the fatigue, if encountered, will be both mental and physical, and partake of the nature of neurasthenia. One must be guided by their judgment and experience as to the amount of exercise given in the beginning, particularly in paralyzed muscles.

Wishing to bring to the profession's attention the practical application of this method of treatment, I will discuss its use in infantile paralysis, lateral curvature, and locomotor ataxia.

In the treatment of infantile paralysis, in addition to the application of massage, the treatment by the galvanic, faradic, sinusoidal, and high-frequency electrical current (I make mention here that electricity should never be given to the point of eliciting pain in children, but merely should be given with the least amount of current that will produce a contraction, and these contractions should not be continued up to the point of exhausting muscle contraction) in children over three years of age, we add a course of muscle education before a mirror, which I regard as one of the most important in its treatment, because recovery is best brought about by the action of the will, influencing action after massage and electricity have brought the muscle under the control of the mind.

The muscles most frequently involved in infantile paralysis are the perineal group, and the plan of exercising one set of muscles can be utilized in another set of muscles involved. Placing the child in a chair before a mirror in a comfortable position, we first approximate the origin insertion of this muscle group by bringing the foot up to a right angle with the leg, and then urge the child to aid in bringing up the little toe side of the foot through an arc of about 30 degrees. If the muscle contraction is such that the child cannot do this alone, the instructor places one hand on the knee to keep the leg in the position, and places the other hand under the foot, which greatly aids the efforts of the child in producing the required contraction. (Fig. 3.) This should be repeated several times, but not to the point of overtiring these weakened muscles. Each set of muscles

should be contracted in a similar manner. If the motion cannot be brought about, still the mental effort should be made for the attainment of this action.

To realize how efficient this method is, I wish to state that through this, combined with other treatment, I have been able to show at medical meetings some 43 patients practically cured, who were unable to walk for periods extending from nine months to four years, having received some form of treatment during this time by other physicians, and been referred to the Hospital for Deformities and Joint Diseases by such able observers as Kerley, Koplik, Mandl, and many others.

In the treatment of lateral curvature, of which many of the worst cases are due to infantile paralysis affecting the muscles of the back, the obtaining of any permanent result depends on equalizing the muscle force or re-establishing in the weaker muscles a strength equivalent to that of the opposite side. This has been brought emphatically to my attention, inasmuch as the curvature made by the overcorrection of the Abbott method returns on the removal of the corrective jacket, and all who have taken up this method, including Abbott himself, now follow up this treatment by muscle education. (Figs. 4 to 9.)

When ordinary gymnastic exercises are prescribed for the correction of lateral curvature, the deformity of the spinal muscles is so much more rapid than that of the weaker group that in place of a beneficial result the deformity is brought about much more rapidly and the development of the stronger muscles holds the deformed position fixed.

If one follows the method herein described, thereby permitting the stronger muscles to atrophy, while all the weakened muscles involved are brought to their highest state of efficiency by being developed before a mirror, rational correction is obtained which is usually lasting, and can be continued by the patient who realizes, from personal observation before the mirror, what is to be accomplished and what has been obtained. With this method we not only increase the actual muscle bulk, but a corresponding development of the diameter of the nerve supplies the muscle with the increased efficiency in the motor area of the brain, from which the stimulus to the muscle originates.

FIG. 6.



Standing position, showing position before mental and muscular effort for correction.

FIG. 7.



Maximum muscle effort at pencil-point, showing correction accomplished.

FIG. 8.



T. W. had spent three years at one of the first and best schools of physical culture and graduated, still having a decided lateral curvature, which she cured by this method of developing her weaker muscles before a mirror.

FIG. 9.



M. S. consulted an orthopaedic surgeon for a beginning lateral curvature, and, on his advice, attended a gymnasium for its correction. After three years of gymnastic work her back is shown in the above photograph. The stronger muscles developing so much faster than the weaker groups, the patient was twisted into the above distorted figure.

The only improvement which has been obtained in locomotor ataxia has been through the redevelopment of co-ordination by exercises. This is known as Frankel's method, and the patient, alone or with the assistant, goes through various exercises, in which steps of equal distances are gone over in various ways. It can be readily seen that in a short time one does these exercises automatically, and when the condition is such that assistance is needed the patient must make a great mental effort to go through the exercises.

What I have to offer, which I think is new, is that the patient in doing his exercises, which is walking toward a mirror, must keep up a mental concentration, observing the action of his feet in the mirror. To this are added these exercises, the patient attempting to touch objects of different colors with his toes, at unequal distances, observing the reflected object in the mirror. The patient can be steadied by an assistant or rest against a table. The tax of the mental concentration is complained of by the patient in the beginning, but the time which he can give to exercises rapidly increases day by day.

I have treated a number of cases by this method, and will briefly cite a few to show what can be accomplished.

H. M., who is secretary of one of our city clubs, was only able to get about with great difficulty with the aid of crutches. During these early exercises it was necessary for assistants to aid him in his work. At the end of six months' treatment he was able to walk three miles without cane or crutch.

R. L. came to the institution walking with a cane and crutch, accompanied by an attendant. After ten weeks he was able to dispense with the cane and crutch, and came from Brooklyn unattended. I had the pleasure of showing this case a few times during his improvement to Dr. Harlow Brooks, and a number of such cases which have been under this treatment, both in my private office and at the hospital, have been observed by various physicians who have visited me.

We have learned from our studies of brain function that in the decussation of the nerves in the brain, where the area of a particular function has been destroyed and the function still continues, other areas in the brain have taken up the function. I am

under the impression that in some cases of infantile paralysis which I have seen it would appear as if the motor impulse conducted from the brain to the periphery had been taken up by other tracts. Whether I will be able at some future time, by autopsy, to prove this statement remains to be seen. Nevertheless, being an observer of over 3000 cases of infantile paralysis, I have seen so many cases of a return of function in paralyzed extremities by the application of this line of treatment, compelling the patients to observe their motions in a mirror, first assisted, later carried on by themselves, that I would advise those who have been discouraged to renew an effort with this plan of treatment, and hope that they may meet with the same agreeable results that I have, and learn what can be accomplished by this work if persevered in for a reasonable length of time.

DIAGNOSIS OF DISEASES OF THE HEART

BY ALBERT ABRAMS, A.M., M.D.

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Qui bene dignoscit, bene curat, postulates the importance of a correct diagnosis to ensure successful treatment. You must disregard many traditions associated with the cardiopathies.

Ever since the cause of the action of the heart has been referred to the muscle itself, and not through the vagi and sympathetic nerves, the literature fairly teems with auricular fibrillation, extrasystoles, and other imposing technicalities, which at the present time are of little value in practical cardiology. I shall now demonstrate what are now known in the literature as the "Heart Reflexes of Abrams," inasmuch as they are of importance in cardio-diagnosis and cardio-therapeutics. When the X-rays traverse the chest of this subject in a sagittal direction and the precordial skin is irritated, the heart contracts in its entirety (Fig. 1).

This phenomenon is the heart-reflex of contraction. If the myocardium is healthy, it is brief in duration, but if the vigor of the latter is compromised, it may last for hours, as shown by Merklen and Heitz in their book on "Diseases of the Heart."¹ The latter I have neologized as "the myocardial reaction of degeneration." If I direct a current of cold air on the precordium, the heart exhibits a slight degree of dilatation (heart-reflex of dilatation), the amplitude of which is exaggerated in this subject who suffers from what I have called cardiectatic angina pectoris. You know that certain individuals suffer from anginoid pains when cold air strikes the chest, and in such instances we are probably dealing with acute dilatation of the heart, which is not unlike contraction of the organ in diminishing the blood supply to the coronary vessels. The reaction of the heart to a current of cold air is important in physiology and pathology.

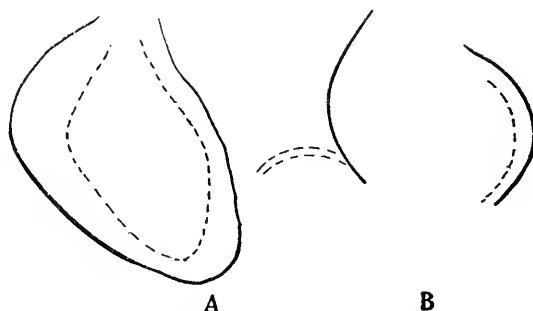
The physiologist has extended the scope of the cutaneous sensory

¹ *Examen et Séméiotique du Cœur.*

nerves by not only endowing them with the sensation of touch but with the sensation of pressure, warmth, cold, and pain. He is now constrained to recognize the puissance of *specific cutaneous nerves* which influence visceral tone; nerves which, in response to a special irritant, will either contract or dilate an organ. The foregoing will furnish a better understanding of percutaneous medication and psychiatrics, which heretofore have been essentially empirical procedures.

The cardiac reflexes show greater amplitude and duration when the seventh cervical spine is concussed to elicit the reflex of contraction and when the paravertebral region between the third and fourth dorsal spines is concussed to elicit the counter-reflex of dilatation. I

FIG. 1.



A, Heart reflex in a boy aged eight years. The continuous line represents the normal outline of the heart and the broken line the degree of cardiac retraction incident to irritation of the precordial skin. B, Heart reflex in a boy aged fourteen years. Duration of reflex implicating the left ventricle only, fifty-five seconds. Both illustrations are rough reproductions from the fluoroscopic picture. The double continuous line in B represents the upper border of the liver.

have shown you the fluoroscopic method of recognizing the reflexes, but accurate percussion is equally available for their recognition. Forceful percussion, however, must be employed to delimit the deep or relative cardiac dulness. If you irritate the precordial skin, the "lung reflex of Abrams" is synchronously elicited. The latter is an acute dilatation of the lungs and encroaches on the cardiac area. It is evident, then, that if light percussion is employed it would likewise yield a diminished area of cardiac dulness. This factor (lung reflex) may be eliminated by discharging the reflexes from stimulation of the spinous processes of the vertebræ.

The multiple uses of the heart-reflexes in diagnosis cannot now be cited. Suppose it is necessary to differentiate cardiectasia from a pericardial exudate. If the deep or relative cardiac dulness is modi-

fied after cutaneous friction, it is in favor of a cardiectasia and excludes the presence of a transudate or exudate in the pericardial sac. Pericardial synechiæ prevent the elicitation of the heart-reflex. A diseased myocardium past restitution or a heart inordinately dilated will show no heart-reflex. I was endeavoring to demonstrate the heart-reflex of contraction to Professor Einthoven, but was unsuccessful. Later it was found that my subject had just recovered from an attack of pericarditis. The heart-reflex of contraction is mediated through the vagus. An injection of atropine (1/64 gr.), by paralyzing the motor endings of the vagus, prevents the elicitation of the reflex in question. Pilocarpine, which has a vagotropic action, accentuates the reflex. These preparations are of great value in the pharmaco-diagnosis of cardiac diseases.

Let me briefly cite a few uses of atropine. If the Adams-Stokes syndrome is caused by overstimulation of the vagus, an injection of atropine will remove the block and will cause the pulse-rate to become rapid, whereas in the myogenic forms the heart-block is unaffected. In other words, atropine will increase the pulse-rate in all cases of bradycardia due either to direct or reflex excitation of the vagus. If atropine is employed between the attacks of paroxysmal tachycardia, and no attack ensues, paralysis of the vagi is not responsible for the paroxysms. Vagus stimulation not only slows the heart-rate, but may also create irregularities in rhythm. If this vagus influence is eliminated by atropine, the irregularities will disappear and thus the neurogenic nature of the irregularity is demonstrated. Any neurosis embraces the entire field of pathology, and this, in all cogency, is applicable to the heart. "The physical is the counterpart of the moral heart." Rest and a few doses of morphine are capable of altering completely the picture of a cardiac disease. Always remember that an adequate dose of atropine may physiologically block a host of reflex cardiac anomalies.

We shall learn in our next lecture that while the recession of the borders of a dilated heart, by eliciting the heart-reflex of contraction, is of short duration, it may now be prolonged for hours—a fact which simplifies and expedites our method of treatment. In disease of any organ, the severity of the lesion may generally be gauged by estimating the capacity of the viscus to execute its functions. This is the equivalent of a functional diagnosis. The latter takes cognizance of

anomalies in the physiologic functions of the viscera. Thus a functional takes precedence over a pathologic diagnosis, for the reason that physiologic fluctuations may be resident in an organ even before a pathologico-anatomic substratum is assumed to exist. It has been truly said that "pathology is the physiology of the sick." In every cardiopathy implicating the nerves, myocardium, or valves, our primary endeavor is to determine the functional capacity of the heart. Many so-called functional cardiac diseases are mere instances of heart-fatigue. Many patients labelled as neurasthenics really suffer from cardiac incompensation.

Many methods have been suggested to gauge the functional capacity of the heart. No method, in my opinion, is superior to the one which I shall now demonstrate. It is based on the fact that when the cardiac muscle is normal, exercise, even when carried to exhaustion and fainting, does not produce dilatation of the heart. On the contrary, the heart diminishes in volume and a veritable heart-reflex of contraction ensues through the afferent sensory impulses from the muscles acting on the vagus. This phenomenon, owing to its origin, has been specified as the myogenetic heart-reflex of contraction.

In myocardial disease, even moderate exercise provokes ventricular dilatation. This test predicates an accurate delimitation of the heart by percussion. If you execute the conventional method of percussion in this subject, you will note that there is only a moderate increase in the area of cardiac dulness, but if you employ my method of vago-visceral percussion,² which signifies augmentation of vagus-tone during percussion, you will observe that the area of dulness is very much increased.

The percussion-sound of the heart is dependent on the tone of the organ. During diastole the walls of the heart are relaxed, but this diastolic relaxation varies with the tonicity of the heart muscle. Fibres exist in the vagus which, when stimulated, increase the tone of the myocardium. By stimulating the vagus the cardiac muscle normally relaxed shows diastolic rigidity. This test, aside from its aid in topographic percussion of the organ, will also reveal its tone. If the myocardium is normal, the precordial dulness is accentuated during vagus-stimulation, whereas in disease which reduces the tone

² The reader should consult "The Tonus of the Vagus" and "Treatment of Exophthalmic Goitre," *INTERNATIONAL CLINICS*, vols. iii and iv, 22d series.

of the organ the dulness is unchanged. Light and the energy of the various forms of force directed on the precordial area will likewise augment the tone of the heart.³

You will observe that moderate exercise has caused a dilatation in lieu of a contraction of the heart. We must not conclude, however, that the myocardium is necessarily degenerated. The functional capacity of the organ is a neuromuscular question. If I depress the vagus (by pressure not exceeding 30 seconds between the third and fourth dorsal spines) by aid of the radicularpressor in this normal individual, a little exercise will likewise cause a dilatation of his heart, despite the fact that the organ is normal. The normal heart can easily adapt itself to the average grades of dilatation. I have made orthodiagraphic tracings of a number of normal hearts during various periods of the day and have determined the fact that the organ is practically never constant in size. You should also know that Kornfeld has demonstrated that the myocardium possesses the property of increasing the size of its cavities without any corresponding augmentation of tension of its walls, a condition which he calls *Ausweitungsfähigkeit*.

With the instrument, which I have called the spondylo-reflexometer, you can measure the tone of the vagus and determine whether it is orthotonic, hypertonic, or hypotonic. The weaker the stimulus necessary to elicit cardiac inhibition, the more diminished is the tone of the vagus. In the norm, in orthotonia of the vagus there is no inhibition of the radial pulse when the pressure exerted is less than 10 kilogrammes. In hypotonia of the vagus the radial pulse is temporarily arrested with pressures varying from 2 to 6 kilogrammes. It is evident, from the foregoing, that the tone of the nerve, which is equivalent to its energy, must always be taken into consideration in our functional tests of the heart. If you auscultate the heart of this subject in whom a cardiectasia has been established, you hear systolic murmurs at the aortic and pulmonic ostia. After auscultating a series of subjects who have been gathered for this occasion you will probably agree with me that little value is to be attached to murmurs from a prognostic viewpoint. No greater tribute can be paid to traditional medicine than the belief that a cardiac murmur is

³ The data respecting this subject will soon be published: "Physiological Physics of the Various Forms of Force."

always indicative of a disease of the heart. Some of the most serious affections of the organ are unaccompanied by murmurs. Murmurs are so commonly encountered without valvular lesions that Laennec was constrained to conclude that they were of no diagnostic importance. Laennec's observation, despite its falsity, directs attention to the frequency of functional murmurs. Potain found accidental murmurs in one-eighth of all the patients seen in his hospital service. Many theories have been suggested to explain accidental murmurs, but I believe, based on manœuvres which I shall show you, that their creation and disappearance are caused by a functional stenosis or dilatation of the aorta, pulmonary artery or the cardiac ostia.

Measurements of the aorta by the orthodiagraph several times a day on the same subjects will show variations in the calibre of the aorta, in accordance with the law that each part of the body receives an amount of blood necessary for its activity. One must not forget this physiologic rhythmicity of the large vessels. When reference is made to functional aortarectia and aortectasis, I refer respectively to contraction and dilatation of the aorta. When the lumen of an elastic walled tube through which liquid flows is narrowed, eddies are created which cause the walls of the tube to vibrate and eventuate in a palpable thrill and a blowing sound called a murmur. This murmur is loudest below the narrowing, and is transmitted in the direction of the flow.

By means of the aortic reflexes⁴ one may contract or dilate the aorta. Similarly, there are reflexes of the pulmonary artery. Here is a normal subject and auscultation shows no murmurs over the aorta or pulmonary artery. By concussing the seventh cervical spine to narrow these vessels and concussing the tenth dorsal to dilate them, we have created by the first manœuvre systolic murmurs, and diastolic murmurs by the second manœuvre.

Here is a tuberculous subject in whom systolic murmurs may be heard over the aorta and pulmonary artery, and you will furthermore observe that they evanesce temporarily by concussion of the tenth dorsal spine which dilates both vessels. These murmurs in tuberculous subjects are frequent. The coarctation of these vessels is in part spasmodic, for the reason that they are often heard at one time and are absent at another time. As a rule, however, in this disease

⁴ INTERNATIONAL CLINICS, vol. i, 23d series, page 54.

the diminished lumina is a permanent condition. Thus in chlorotic subjects in whom such murmurs are frequent there is a hypoplasia of the vessels (diminished lumen) with extreme elasticity.

Here is a chlorotic subject in whom the murmurs can be made to disappear by dilating the blood-vessels. In this subject with a thoracic aneurism the murmur disappears by concussing the seventh cervical spine, which temporarily contracts the aorta. In our subject with cardiectasia the systolic murmurs disappear after concussion of the seventh cervical spine. Here we are dealing with the murmurs of a relative valvular insufficiency. The manœuvre which we have executed induced the heart-reflex, which, by causing myocardial contraction, reduced the size of the cardiac orifices, thus enabling the valves to close the openings. As an excitant to the seventh cervical spine, you may also employ a powerful sinusoidal current, or you may elicit the heart-reflex by percussion of the precordial region with a percussion hammer.

Here is a subject with splanchnoptosis in whom a loud systolic murmur may be heard over the aorta. Now, by raising the abdomen during the time of auscultation the murmur disappears. Cardiopptosis, or ptosis of the heart, is a participating phenomenon in practically every case of Glénard's disease, insomuch as the position of the diaphragm, and with it the heart, is influenced by intra-abdominal tension. If one reduces intra-abdominal pressure by means of a large vacuum cup applied to the abdominal wall, one may often cause the appearance of systolic and pulmonary murmurs so long as suction is maintained. I assume that in splanchnoptosis the concurrent low heart (bathycardia), by traction on the aorta, narrows the vessel and thus causes the murmur, and raising the abdomen overcomes the traction.

In this anæmic subject systolic murmurs are audible at the pulmonary and aortic ostia. The loudness of a murmur is largely dependent on the activity of the heart. When loud murmurs become weak in organic affections of the heart it is often an ominous sign and suggests weakness of the heart. For the same reason murmurs may disappear in the febrile diseases and in the dying state. Faint may often be converted into loud murmurs after increasing cardiac activity by exercise and cardiotonic medication. Complete compensation may often cause the temporary disappearance of a murmur.

Hæmic murmurs are more readily inhibited than organic murmurs, and when the murmurs of anæmia are inhibited they are replaced by tones.

By inhibiting the action of the heart or reducing its activity in this anæmic subject by pressure with the radicularpressor at the third dorsal spine the systolic murmurs disappear and are replaced by faint systolic tones. In this rapid and irregular heart the murmurs may be attributed to the delirious state of the organ. To discipline this heart and reduce its frequency one may have recourse to aconite (tincture is most reliable), digitalis, or strophanthus. At least 36 hours would elapse before any decided action could be expected from digitalis. The intravenous employment of strophanthin would act in about one hour. You may reduce the frequency of the heart at once by means of the radicularpressor, making pressure at the seventh cervical spine during the time of auscultation. This action on the chronotropic fibres of the vagus may be more effective at the fifth or sixth cervical spine. In this patient with a subclavian murmur the diagnosis of an organic cardiac murmur has been made and he was rejected by an insurance company.

Note the following, which enables you to diagnose this murmur, which is not infrequent; it is usually a succession of murmurs intensified by deep inspiration, suspension of respiration, and voluntary stretching of the neck. It is often of momentary duration, and may disappear after a few deep inspirations. Its dependence on the phases of respiration distinguishes it from all transmitted murmurs. Neither its character nor duration is ever uniform from one examination to another. Its character may be modified by raising or lowering the arm. In nearly every subject one may create an arterial subclavian murmur by raising the arm gradually until it assumes a vertical position.

My next lecture will be devoted to the treatment of cardiac diseases.

THE TREATMENT OF THE COMMON ANIMAL PARASITIC DISEASES, INCLUDING GRAIN ITCH

BY FRANK CROZER KNOWLES, M.D.

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pensary of the Pennsylvania Hospital

BEFORE taking up the treatment of the animal parasitic diseases, one should have an absolutely clear conception of the resemblances and the differences between these affections.

Scabies, or the "itch," is caused by a diminutive mite that burrows into the horny layer of the epidermis, making a zigzag track, varying from the smallest fraction of an inch to one-quarter of an inch in length. This track or burrow shows alternating black, or brownish-black, and white dots, the former being the excreta and eggs laid by the female. These animals burrow into the epidermis where the skin is thin, warm, and there is more or less moisture; therefore the diagnostic tract is found chiefly on the inner surface and the webs of the fingers, the flexure surface of the wrists, the axillary folds, on the penis in the male and around the nipple in the female. The eruption caused by rubbing and scratching and secondary pus infection is found most abundantly on the hands, the fingers, the flexure surface of the arms, the axillæ, the anterior surface of the trunk, the buttocks, the flexure surface of the legs, chiefly the popliteal spaces, the ankles, the feet and the toes, on the breasts, chiefly around the nipples in the female, and on the penis in the male. The face is never attacked by the disease in the adult or in childhood, the one exception being the nursing infant, infection of the face occurring from the numerous lesions usually found near the nipple of the female. The disease is extremely contagious, and it not infrequently runs through an entire household; it is very exceptional not to find more than one case in the family.

The itching is so severe that frequently the patient is kept awake a great portion of the night. There is very little pruritus during the day. The itch mite does not start to migrate from its burrow until the patient's body is thoroughly warmed up in bed at night; the mite then migrates over the surface of the body, and the itching is almost unbearable. The greatest itching, therefore, is complained of one or two hours after the patient has retired, and may continue the greater portion of the night.

Pediculosis corporis has to be carefully differentiated from scabies, so it would be well to describe this condition in more or less detail.

Pediculosis corporis, pediculosis vestimenti, or louse of the body, is caused by a tiny little animal approximately the size of a very small pinhead. This little animal is found in the seams of the patient's underclothes or on the skin surface; it lays its eggs in the underclothes or on the integument. There are three characteristic signs we look for in this disease: the animal, long, linear scratch marks, and small, punctate hemorrhages. The linear scratch marks have been produced by the patient's nails because of the intense itching, and the punctate hemorrhages have been caused by the little animal putting its head into the skin and sucking the blood from its victim, a small pinhead-sized red puncta remaining after the animal has withdrawn its head. In pediculosis corporis, or louse of the body, the face is unattacked; the hands and the feet likewise are free of eruption. The lesions are observed on the extensor surface of the extremities. The most marked outbreak is noted across the shoulders and the lower portion of the back; there is comparatively little eruption on the anterior surface of the trunk. The axillæ are free, and also the flexure surface of the extremities. The penis shows no lesions, and neither do the breasts. The site of the outbreak can be very easily explained if we only recall the fact that the lice are in the seams of the underclothes and therefore the lesions are found where the animals are in contact with the skin surface. The itching is most marked at night and when the patient removes the underclothes. This has the natural explanation that with the removing of the underclothes the animals are disturbed in the seams of these nether garments and crawl to the surface of the skin; the crawling of these animals where the seams of the underclothes

have rested causes intense itching; the patient literally claws the skin, causing excoriations and long, linear scratch marks.

Grain itch is caused by a diminutive mite found in straw, wheat, barley, and other cereals. The eruption resembles markedly both the lesions of urticaria and of varicella, consisting of a wheal surmounted by a vesicle. The hands, the feet, and the face are rarely attacked. The majority of the outbreak is observed upon the trunk; the extremities show much less involvement. The disease is usually seen in the spring or the autumn. The itching is most severe at night. Those sleeping on new straw mattresses are observed to have the outbreak, the straw having been improperly cared for before the mattress was made. The itching is most severe after the patient has been lying on the mattress for some hours.

These three pruritic diseases, each caused by an animal parasite, are to be differentiated before the proper treatment toward cure can be instituted. Before taking up the therapeutic measures several points in differential diagnosis should again be emphasized: endeavor to find the cause of the affection—the itch mite or the burrow, the pediculus or the egg, or the grain itch mite; take into consideration the distribution, whether the hands and feet are attacked, the extensor or flexure surfaces of the extremities, or the trunk, the anterior or posterior surface, or certain fixed areas, such as the penis, the breasts, and the axillæ; the type of lesions—multiform, long, linear scratch marks, and punctate hemorrhages, or wheal and varicella-like lesions—and the time of the most intense itching,—upon removing the underclothing, shortly after being warmed up in bed, or several hours after retiring.

The treatment and the cure of scabies is a very simple matter if the full details are thoroughly emphasized to the patient. It is to be remembered that the omission of any small portion of the instructions may lead to making the condition worse in prolonging or preventing the cure. In the beginning it is well to realize the logic for each stage of the procedure. The first indication is naturally the killing off of all of the animal parasites that cause the affection. As the itch mites come to the surface to breathe it is necessary to have the germicidal ointment constantly in contact with every portion of the body attacked by the disease, so that the parasite is killed when it pokes its head out of the burrow to breathe. The

directions, therefore, are given the patient to rub the ointment on the entire cutaneous surface, with the exception of the face and the scalp, as these latter areas are not attacked by the disease; this procedure is carried out for four nights in succession. On the fifth night a warm bath is taken, using plenty of white castile or boric-acid soap. After the ointment has been removed by the bath the patient's body should be thoroughly examined, to determine whether the patient's skin has been irritated by the germicidal application; if the skin is somewhat inflamed but there are still evidences of scabies remaining, such as burrows and pustular lesions, two or three days should elapse to allow the inflamed condition of the skin caused by the germicidal ointment to subside, and then another series of rubbings for four nights in succession should be instituted. Another warm bath should again be taken on the fifth night. The two series of rubbings cure practically every case of scabies. It is not necessary to bathe before starting the germicidal treatment, because the ointment is the curative portion of the treatment and soap and water have practically no effect in the eradication of the disease. The same underclothes and bedclothes should be used during the treatment, as the preparations used are apt to stain. Next to the germicidal ointment which destroys the cause of the disease in the skin, the most important measure is the thorough disinfection of all those clothes—the nether garments, the night clothes, and the sheets on the bed—which touch the patient's body, in order to kill the mites which may be present. A great many germicidal preparations are curative in scabies, but, as none are better than sulphur, we use this drug in the majority of our cases. Although the English are fond of the sublimed sulphur, we prefer the precipitated, as the latter is more finely divided and of a less gritty consistency, and can therefore be more readily rubbed up into a smooth ointment. Precipitated sulphur is used routinely in these cases in the strength of one drachm to the ounce of a thin base, such as petrolatum, equal parts of petrolatum and lanolin, benzoated lard, or cold cream. In warm weather two to four drachms of lanolin should be combined with the other thin bases mentioned, otherwise they are almost too thin for use. The balsam of Peru, not only because of its pleasant odor, but also because of its germicidal action, may be combined with advantage with the sulphur preparation, in the strength of a half

drachm to a drachm to the ounce. Betanaphthol may be used in the strength of thirty to forty grains to the ounce in the treatment of this condition, or may be used in combination with the sulphur, one-half drachm to the ounce. Numerous other preparations of a germicidal character have been suggested for the treatment of the adult with the "itch," but as they have no advantages over those therapeutic measures just mentioned, and may have great disadvantages, there is, therefore, no reason why they should be considered. I would like, however, to emphasize that under no circumstance should any mercurial ointment be used over such a large surface, not even ammoniated mercury, because of the dangers of pyalism. Raposi's naphthol ointment is a pleasant preparation to use, and consists of 15 parts of betanaphthol, 10 parts of precipitated chalk, 50 parts of soft soap, and 100 parts of lard. Sequeira suggests one ounce of balsam of Peru, two ounces of sublimed sulphur, one-half ounce of potassium carbonate, and six ounces of lard. The rubbing of an ointment over the greater portion of cutaneous surface and allowing it to remain for four days is disagreeable at best, and therefore I believe that as satisfactory a preparation as any consists of precipitated sulphur four drachms, one and one-half ounces of lanolin, and two ounces of petrolatum, the four ounces being sufficient for four nights of treatment. The sulphur ointment should be used one-half as strong for a child from three to ten years, and from ten to twelve forty grains of precipitated sulphur to the ounce of the base, above twelve years the same strength preparation is employed as for an adult. Balsam of Peru, one drachm to the ounce of the base, has been used in the treatment of young children under the age of three years, the sulphur being omitted from the prescription. The mildest germicide and the least irritating to the skin of the very young child and the nursing infant is storax (*Styrax*), a liquid balsam, which is combined with an equal quantity of olive oil and the usual scabies procedure followed.

Not infrequently after the second series of rubbings in the treatment of scabies the patient returns to the office and mentions the fact that the itching is quite severe, but chiefly noticed during the day rather than during the night. You then know that the germicidal ointment has inflamed the skin, setting up a dermatitis.

The scabies has been cured, as the patient has carefully followed your instructions, and your present indication consists in soothing the irritated skin. Mild antipruritic lotions, dusting powders, or ointments should be used for this purpose. Phenol lotion can be used to advantage, seven and one-half grains of phenol, powdered talcum one-half drachm, to prolong the antipruritic effect of the phenol, glycerine 10 to 15 minims, so the lotion does not dry too rapidly, and water, or camphor water which is slightly antipruritic, one fluidounce. If the itching is quite severe, thymol, one-quarter grain to the ounce, may be added to the lotion. A very satisfactory preparation in the event of the pruritus being more or less localized to a few areas consists of camphor ten grains, menthol two grains, powdered bismuth subcarbonate or powdered zinc oxide, powdered starch, two drachms of each, and petrolatum one ounce. Dusting powders work very nicely in some of these cases, such as thymol one-half grain, ten grains of camphor, five grains of phenol, one drachm of boric acid, and powdered talcum one ounce. If the skin is quite inflamed, both soap and water are contraindicated and the skin surface should be cleansed with plain yellow petrolatum or olive oil.

As scabies is an exceedingly contagious disease, the patient should be warned to sleep alone and to allow no one to touch the infected clothing.

The treatment of pediculosis corporis and scabies is very different because of the diverse habitat and habits of the causal animal parasites; in the latter disease the cause is found in the epidermis, while in the former condition the pediculosis is found on the integument. Therefore in pediculosis corporis a germicidal ointment is not necessary; a warm bath with plenty of good castile or boric-acid soap destroys all of the parasites. The only other indication for treatment is to soothe the skin and to eradicate the pruritus. A phenol lotion is our first thought, a good formula consisting of phenol seven and one-half grains, powdered talcum, powdered zinc oxide, or one of the bismuth powders, in the strength of one-half drachm, glycerine ten minims, camphor water one fluidounce. If the pruritus is very marked, one-quarter grain of thymol or one grain of menthol may be added to each ounce of the mixture. This preparation may be applied freely and frequently without danger

of poisoning from absorption, if the body is not bandaged. The other antipruritic preparations mentioned for the treatment of the dermatitis following scabies may also be used with impunity and efficacy in this condition. All the patient's underclothes, night clothes, and the sheets on the bed should be thoroughly boiled to kill the pediculi in these garments.

The first indication in the treatment of grain itch consists in getting rid of the straw in the mattress and substituting fresh straw that has been properly dried and treated. Apparently the bulk of the infected straw has come from certain portions of New Jersey, although other sections of the country have reported the condition as well. The mattress can also be subjected to dry heat and the parasite thereby killed. The same safeguard should be employed with all infected cereals. The parasite is apparently killed if the straw is kept for some months, particularly during a winter, the cold weather acting as a cure for the diseased straw. The patient should be warned, therefore, to immediately stop sleeping on the disease-producing mattress.

In this condition a germicidal ointment is also indicated to kill all of the minute animals that may have attacked the skin. The germicidal ointment is used only about one-half the strength of the preparations prescribed in scabies treatment. A good prescription consists of precipitated sulphur one-half drachm, betanaphthol fifteen grains, benzoated lard one ounce. The therapeutic measure should be used at bedtime, for four nights in succession, every portion of the body being anointed excepting the face and the scalp. A warm bath should be taken on the fifth night to remove the germicidal ointment from the skin surface. A second series of rubbings is rarely required in this condition. If the skin still remains irritable and pruritic, one of the antipruritic and soothing preparations mentioned under the post-scabies dermatitis or for pediculosis corporis may be used.

In order to complete the description of the more-usually-found animal parasitic conditions, a short *résumé* of pediculosis capitis and pediculosis pubis should be given and their appropriate treatment.

Pediculosis capitis is caused by a small, pinhead-sized animal somewhat smaller than the corporis type and with an entirely different habitat and treatment. The little animal limits its activity to

the hairy scalp and lays its eggs on the hairs in this region. Our diagnosis is absolutely clear if we find the eggs of the little animal on the hairs, even if the living animal is not found. The egg may be found on any portion of the hair, and hangs in the direction in which the hair grows; it is somewhat elongated, pinhead in size, of a yellowish-white, translucent appearance, glistening, and the external portion consists of a gelatinous, albuminous material. If the egg is dead the capsule is of a dull grayish-yellow color and the glistening surface has entirely disappeared; therefore it is very easy to determine whether the capsule of the egg contains a living or dead embryo, or if the pediculus has been hatched out. The pruritus associated with this condition is frequently intense; the patient naturally scratches, and a secondary pus infection may ensue. Large, pustular lesions, therefore, may be found secondary to scratching on the scalp, not infrequently the face, and sometimes the neck and the hands. From the scratching and secondary staphylococcic infection there may be infection of the lymphatic glands of the neck, usually the posterior or the anterior cervical; the enlargement in most instances is non-inflammatory, but at times suppurative. If the condition continues over a long period the child may become quite anæmic. The importance of the proper treatment of this condition is thus readily seen. The therapeutic measures depend almost entirely upon the amount of inflammatory reaction present and the number of pustular lesions.

If the inflammatory symptoms are not marked and there are but few pustular lesions, the best mixture to be prescribed consists of the bichloride of mercury one-half grain, glacial acetic acid twenty minims, water one fluidounce. The bichloride of mercury kills the animal, the acid softens the albuminous and gelatinous shell of the egg, and therefore the logic of the treatment. The patient's scalp should first be washed with plenty of warm water and a mild soap, such as castile or boric-acid, the suds remaining in contact with the hair for five to ten minutes, because of their softening effect, before being removed with the warm water. The hair should be washed each day for a week. The germicidal lotion should be applied thoroughly twice daily. The hair should be thoroughly combed once or twice daily with a fine-toothed comb. As the nit is attached to the hair shaft in the direction in which the hair grows,

the method of combing the hair should be reversed, as by this measure not infrequently the nit catches between the closely-placed teeth of the comb and is thereby removed, while by the routine method the nit usually passes between the teeth without being detached. If there is a considerable amount of inflammation present or if crust formation is a marked feature, an ointment is indicated, consisting of ammoniated mercury twenty to thirty grains to the ounce of petrolatum or cold cream. As a further antiseptic or germicidal precaution salicylic acid five to ten grains, salicylate of soda ten to twenty grains, or boric acid twenty to forty grains may be added to the other ointment. Precipitated sulphur, twenty to forty grains to the ounce of the ointment base, may be substituted for the ammoniated mercury, but the later prescription is more irritating than the white precipitate ointment and not so curative for the pustular lesions.

If there is marked enlargement of the glands of the neck, an ointment may be required for soothing and absorptive purposes. There is no better ointment for this purpose than the time-honored ichthyol salve, consisting of ichthyol two drachms to six drachms of petrolatum; it will be found desirable in warm weather to thicken this prescription by the addition of from one to two drachms of powdered zinc oxide and to reduce the petrolatum from six to four or five drachms. A great many physicians do not get the full effect of the ichthyol because they use this preparation only ten or twelve and one-half per cent., rather than in the strength of twenty-five per cent.

The third variety of pediculosis—pediculosis pubis—is caused by a small, pinhead-sized animal, smaller than either of the other two pediculi, which bears a very strong resemblance to a crab, hence the term crab-louse or the popular name for the disease, "crabs." This little animal is frequently found as a black dot at the entrance to the hair follicle, with its head buried in the skin. It lays its eggs on the shaft of the pubic hairs, on all hairy portions of the body, including the axillary hairs, the eyebrows, the eyelashes, the beard, and moustache. The disease attacks, in the great majority of the cases, the pubic region alone or the contiguous hairs, and the itching is intense. The preparations suggested for the treatment of pediculosis capitis are equally efficacious in this affection. For

many years the official ointment of mercury, "blue ointment," has been used in the treatment of this disease, but it has several disadvantages: first and foremost, there is a very grave danger of pyralizing the patient; second, it is apt to cause a dermatitis when vigorously applied; and, third, it is both disagreeable in odor and in application. The ammoniated mercury, thirty or forty grains to the ounce of a thin ointment base, has neither of the last two disadvantages and is not nearly so apt to pyralize the patient. If there is a considerable amount of irritability of the skin even beyond the attacked areas, a phenol lotion, seven and one-half grains to the fluidounce of water, may be indicated in addition to the germicidal preparations. All those clothes which are in contact with the diseased areas should be thoroughly disinfected; an hour's immersion in hot water eradicates the danger of reinfection from this source. Although it is hardly practical in most cases, the fumes of chloroform will anæsthetize all of the pediculi which may be feeding with their heads burrowed into the skin and cause them to drop off. The latter method is, however, hardly to be recommended excepting in selected cases.

FETAL PRODUCTS IN THE TREATMENT OF CARCINOMA (FICHERA'S METHOD)

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THE medical treatment of carcinoma is probably as old as the history of medicine and is the history of many measures which aroused hope and enthusiasm for brief periods of time. The value of the ancient arsenic-laden Oriental Pill may be ascribed to the inability of the older physicians to differentiate syphilitic from malignant disease, but the vaunted claims made for condurango, chelidonium, conium, phytolacci, and other drugs attest the credulity of the therapeutic enthusiast. Despite the failures of the past, hope wells perpetual in the medical breast that a specific against cancer is about to be discovered. Instead of arsenious oxide, selenium, and tellurium, the colloidal compounds of copper, gold, and silver and the more complex chemical compounds of arsenic, chondroctin sulphurate of sodium, radioactive liquids and other substances are now being exploited in the treatment of carcinoma. Occasionally the spontaneous disappearance of a sarcoma from a patient receiving herb teas re-excites interest in botanic preparations.

Much attention has also been given to various organic compounds. Beatson's ovariectomy for the restraint of carcinoma has been succeeded by the administration of products derived from the ductless glands such as the thymus and thyroid, and spleen, and by the use of trypsin from the pancreas. None of these substances is specific. Hodenpyl's ascitic fluid, secured from a patient in whom there had been a spontaneous retrogression of a carcinoma of the liver, seemed, but for a brief period of time only, to have a remarkable influence upon malignant tumors in other patients. Coca's experiments with injections of emulsions of malignant tumors of a similar histology at first seemed very promising, but more extended trial proved that they were usually ineffective and often dangerous from streptococcic contamination. The results obtained by the use of cytolytic antisera

as used by Vidal, partially confirmed by Beebe, suggest the need of further investigation in this field. The mixed bacterial toxins of Coley, and Otto Schmidt's cancrroidin or antimeristem have likewise failed to justify the early commendatory reports of their introducers.

In October, 1911, Dr. G. Fichera,* of the Surgical Institute of the Royal University of Rome, published a preliminary note claiming a remarkable action of homogeneous fetal autolysates on malignant tumors in man. The treatment was based chiefly upon certain experiments made upon rats, especially experimental evidence that rats acquired an immunity to the inoculation of neoplasms from the injection of emulsions of embryonic or fetal tissues.

As is well known, the injection of certain animal cells into the living organism stimulates the production of substances antagonistic to or solvent of these cells. Thus a solvent for liver cells is evoked in the body by injecting an emulsion of hepatic tissue, a solvent of renal epithelium by injecting an emulsion of the cells of the kidney; a spermatolysin, by injecting spermatozoa and so on. The injection of an emulsion of the cells of a malignant tumor as practised by Coca has, at times, been followed by the absorption or destruction of a corresponding tumor within the animal body.

The most striking example of the acquired proliferation of cells of an embryonic character is that characteristic of malignant tumors. In these tumors the essence of the malignancy is the unrestrained cellular proliferation. It makes little difference whether the cellular proliferation be explained by Cohnheim's theory, by the parasitic theory or other exciting agency; if the element of abnormal cell proliferation be abolished the malignancy ceases. Therefore, if one cannot directly attack the exciting cause of malignant tumors, but yet may prevent the effect, that is the peculiar unrestricted cell proliferation, he has an available means of cure.

Fichera emphasizes the fact that in early and embryonic life the conditions leading to the genesis of malignant tumors do not exist. Any tumors, and especially malignant tumors, are exceptional in the young and newly-born, and embryonic tissues, he contends, contain elements antagonistic to malignant tumor development. Young rats are resistant to tumor inoculation and older rats when injected with

*The Action of the Products of Homogeneous Fetal Autolysates on Malignant Tumors. *Lancet*, October 28, 1911.

fetal emulsion become resistant to the development of malignant tumors. Inoculated neoplasms in rats undergo involution when emulsified fetal or embryonic tissue is injected or applied locally.

Since September, 1909, Fichera has treated advanced and hopeless conditions of malignancy in human beings by the injection of fetal or embryonic autolysates. Of thirty-six patients so treated he reports that eighteen either discontinued treatment or have been treated for too short a period of time to permit satisfactory conclusions. Of the remaining eighteen, eight showed no marked benefit, five have been distinctly benefited and five apparently cured. He asserts that the autolysates produce no immunity to cancer and must be continued until every carcinomatous cell has been destroyed, otherwise there will be a recurrence. The effects are most marked when the injection is made directly into the tumor; but good results also occur from injections made in distant parts of the body. The local injection produces a distinct reaction with the production of marked serous and cellular infiltration and the production of hemorrhagic, necrobiotic and necrotic areas. The reported microscopic observations include a diffuse cytolysis of the tumor cells, and intense perivascular infiltration of phagocytes, marked exudation of serum, and active proliferation of connective and vascular tissue and the transformation of the immature neoplastic tumor cells in the adult connective tissue cells with the cessation of the infiltrative tumor growth as a result of the injection. The change in size of the tumor does not always correspond to the neoplastic destruction. The metastatic growths are said to disappear under the treatment before the primary tumor. In some instances the rapid proliferation of the tumor overbalances the cytologic effects of the remedy. In such cases the possible value of extirpation of the bulk of growth is suggested.

The autolysates are prepared from human embryos and fœtuses of from two to six months of intra-uterine life. The fragments of minced tissue being placed in physiologic salt solution in the proportion of one gramme to twenty centigrammes, a suitable quantity of thymol or phenol is added and the solution covered by a layer of sterilized oil or toluene, and incubated at 37° C. for about two months. Having tested the sterility of the autolysate, it is injected in doses from 2 to 3 Cc. twice to four times a week, the injections being made subcutaneously or directly into the neoplasm.

In considering any new medical measure for the treatment of carcinoma, the following points should be emphasized:

First.—The spontaneous and experimental malignant tumors of mice and rats differ greatly from the spontaneous malignant tumors of human beings. The tumors in rodents often undergo remarkable involution changes from slight cause. Recently in Philadelphia a number of mice with spontaneous tumors were merely moved from one part of the city to another, whereupon the tumors rapidly disappeared. In the first house where these mice were confined, the neoplasms were endemic and caused the death of the mice in the course of two or three months. Inoculations of the tumor when the mice were kept in another building were usually unsuccessful, although successful when the inoculations were made with a similar technic in the first house.

Injections of various substances, animal extractives, such as emulsion of the spleen, various sera and certain chemicals produce in rats and mice an immunity against tumor inoculation or a retrogression of a growing tumor. Fichera's experiments as to the tumors of rats are therefore not unusual and prove no specificity.

Second.—Malignant tumors in human beings rarely show continuous progress. There are periods of apparent arrest or involution. At times, as in a withering scirrhus, the improvement may be so great as to deceive one into believing that a cure is being obtained. The use of a remedy during a period of retrogression in a tumor is a not unlikely coincidence capable, however, of favorably impressing even an impartial observer. Usually, however, the new remedy is given by an enthusiast and the patient, grasping at the straw of hope, picks out and emphasizes the favorable symptoms so that he, as well as the trained observer, is, for a time, often deceived. It is not strange, therefore, that the early reports of Coca, of Baird and Rockwell, of Schmidt, of Fichera and others should be favorable for the special remedy employed.

Third.—The defective vascularization and the vitality of malignant neoplasms predispose them to involution and necrosis. In carcinoma this produces the characteristic crater-like ulcer. The injection of nearly any substance into the centre of the tumor may precipitate this tendency to necrosis so that reactive infiltration, liquefaction and disintegration of a part of the tumor may result.

The excessive formation of fibro-connective tissue, the compression and partial obliteration of the alveoli of the tumor, neither indicate the obliteration of the tumor nor the safety of the patient. How frequently as a withering scirrhus progressively dwindles in size, or as the fibrosis and the apparent extinction of the tumor produced by the X-rays are going on, secondary growths appear in the bones or internal organs and destroy the patient!

The clinical and histologic evidence given by Dr. Fichera, therefore, is obviously insufficient unless corroborated. Fichera's suggestion, however, seemed not only so novel but based upon such interesting series of laboratory observations reinforced by the encouraging results obtained in human practice that the method was considered worthy of trial.

In November, 1911, therefore, shortly after learning of Fichera's work, we began the use of embryonic products in the treatment of patients with hopeless and inoperable malignant disease. Fifteen selected embryos or fœtuses ranging in intra-uterine development from six weeks to seven months were employed in preparing the products for injection. The autolysate prepared by the method of Fichera did not seem to be a satisfactory product. Toluene, as well as thymol and phenol, precipitate or fix the proteids of the solution and prevent autolysis. It was found, therefore, that the bits of tissue in the solution became white and firm, and despite incubation for several months the particles were not digested, and only minute quantities of proteids or peptone could be found in the solution. We, therefore, prepared a stronger autolysate, pulpifying the tissue by passing it through a meat chopper, mixing it with glycerine and salt solution, and incubating under liquid petrolatum. Usually minute quantities of camphor or chloretone were added to prevent the development of moulds. In this way heavy proteid solutions giving a marked biuret reaction were obtained. It was found difficult to produce satisfactory autolysis with an absolute sterility with the solution. Besides the light and heavy autolysate we also prepared fresh fetal emulsion by grinding the embryos with an equal bulk of glycerine and expressing the product through fine sterile cloth, or filtering after macerating the emulsion for some days. Injections of from 2 to 6 Cc. of these various products were injected at intervals of two days or longer, the injections being made subcutaneously or into the

neoplasm or metastatic growth. Only patients with recurrent or inoperable forms of malignancy were selected for treatment. The injection produced, as a rule, little local irritation, except a primary burning sensation which was more marked from the glycerine emulsion. From certain of the solutions there were a few instances of local necrosis or suppuration at the point of injection due to bacterial contamination. No characteristic reaction was found to result from the injection. The primary effects obtained from treatment were encouraging. The patients often felt much better and seemed to have increased strength and diminished pain. In one instance the œdema of the arm from a recurrent carcinoma of the breast largely disappeared. In another it was believed that the intraperitoneal effusion from a primary carcinoma of the ovary had diminished. Eventually it was observed, however, that despite the encouraging earlier symptoms which were noted less frequently as our early enthusiasm cooled in no instance was there an absolute and progressive improvement that could be entirely attributed to the method of treatment.

That the method is not free from danger is indicated by one death, apparently the result of anaphylaxis. The patient, a married woman of 38 years, was being treated for recurrences in the neck and axilla following a radical operation for carcinoma of the breast. She had previously had the Shafer vaccines and finally was given injections every second or third day with fetal emulsions and autolysates derived from various embryos. After several weeks of the treatment the patient seemed greatly improved; opiates were required much less often; the marked œdema of the arm largely subsided; and the metastatic masses into which the injections had been made showed some evidence of softening. The patient lived in a different State and the fetal products were mailed to her family physician, who made the injections. Three months after beginning the treatment an injection was followed in one and one-half hours by cyanosis and somnolence which gradually passed off in two or three hours. Two days later the physician, not appreciating the previous ominous symptoms, repeated the injection, and one hour later the patient had a pronounced chill and became cyanosed and comatose and soon after died.

In some instances in which the patient died during the course of the treatment from the progress of the disease, friends or the

attending physicians expressed themselves as impressed with the benefit of the treatment, and regretted that it had not been used earlier, although it seemed very clear to the impartial mind that the injection had been absolutely valueless except for the encouraging mental suggestion produced. Unfortunately, we have obtained no evidence that indicates that the use of fetal products has any specific action in the treatment of malignant disease in the human. One thing impressed us, and that was the credulity of the average medical mind in using any novel treatment in a condition generally believed to be incurable.

A partial summary of the patients treated is appended. In a number of instances the fetal products were sent to physicians in various parts of the country; the patients died during or after the treatment and no report of the details was obtained.

CASE 1.—Mrs. W. Age 38. Rapid recurrence in the neck and axilla, after a radical operation for carcinoma of the right breast. Previous treatment by Schafer vaccines and *Bacillus neoformans*. Fetal emulsions injected subcutaneously or into the neoplasm every second or third day for three months. Early progress rather encouraging. Fatal from anaphylaxis as described above.

CASE 2.—Mrs. X. Age about 60. Carcinoma of the breast of slow evolution with associated uterine fibroids and nephritis. The patient exsanguinated from uterine hemorrhages. Fetal emulsion employed for some weeks seemed to encourage the patient and her friends. After a hysterectomy and amputation of the breast the patient, relieved of the hemorrhage, improved. There is no indubitable proof of marked improvement from the injections.

CASE 3.—Mrs. M. Age 60. Cystic carcinoma of thyroid of very slow evolution treated several years before by partial extirpation. Gradual recurrence with formation of hemorrhagic cysts. The patient expressed herself as feeling much better after a single injection and the evacuation of a distended cyst. After three injections the patient did not return, but evidently was not cured.

CASE 4.—Mrs. L. Age 56. Advanced carcinoma of the stomach. Slight symptomatic improvement. Five injections were given, after which the patient did not return.

CASE 5.—Mr. C. Age 60. Advanced carcinoma of the stomach. After the first injection the patient said the pain was largely relieved and that the swelling was much easier, but he did not return for treatment after two injections.

CASE 6.—Mrs. P. Age 44. Ill over one year, with multiple secondary carcinomata of the liver. The patient was jaundiced and very feeble. One injection given, the patient dying about two weeks later.

CASE 7.—Mrs. A. Age about 38. Recurrent carcinoma of the peritoneum following an operation for ovarian carcinoma. After two injections the patient expressed herself as more comfortable with less gas and with her first spontaneous bowel movement. After injections on alternate days for several weeks, the patient, who was evidently losing ground, was aspirated and died the following day.

CASE 8.—Miss M. A small but inoperable carcinoma of the sigmoid and peritoneum. Hodenpyl's ascitic fluid also used. No distinct improvement, the patient dying about a month after the treatment was started.

CASE 9.—Dr. X. Age about 56. Advanced carcinoma of the tongue with metastases in the neck. Very vigorous treatment with injections into the growths and into the arm. Colliquative necrosis in the tumor from the injections. Curettement and drainage. Persistent treatment for five months with patient, and his friends much encouraged. Progressive failure and death.

CASE 10.—Mr. X. Age about 40. Sarcoma of the arm with necrosis finally requiring amputation. Marked general improvement followed the amputation of the sloughing growth, with later pulmonary metastasis and death.

CASE 11.—Mrs. P. Age 37. Sarcoma of the forearm previously restrained for three years by X-rays and repeated extirpations. Several areas of necrosis within the tumor produced by the injections, but no distinct restraint of the growth. An amputation finally was necessary, but was soon followed by signs of secondary sarcoma of the lungs and death.

CASE 12.—Mr. F. Minute recurrence of epithelioma in the lip which had been resected a year previously. Injection into the recurrence. Marked swelling and evidence of increased growth. Secondary resection of the lip. No recurrence reported after ten months.

CASE 13.—Mrs. Y. Age 42. Carcinoma of the ovary removed five years before. Re-operation for generalized peritonitis three years ago. Bedfast for five weeks. Has been using codeine for months and for the last two weeks morphine. After three injections of fetal emulsion the pain was reported as less and the constant vomiting, from which the patient had previously suffered, had greatly improved. It is believed that the patient died not long after this report.

CASE 14.—Mrs. H. Age about 42. Recurrent carcinoma after amputation of the breast. Rapid progress despite the use of fetal emulsion; death.

CASE 15.—Mr. F. Age 60. Carcinoma of the stomach and liver. Previous gastro-enterostomy. No improvement after two weeks' treatment.

CASE 16.—Mr. Q. Advanced carcinoma of stomach. Patient improved after taking the treatment and was soon able to leave his bed. Then the condition rapidly progressed to death.

CASE 17.—Mrs. B. Age 74. Carcinoma of the nose implanted on an area of lupus of very slow evolution. No distinct influence from injections of fetal emulsion.

CASE 18.—Mrs. H. Age 44. Pelvic recurrence after radical operation for carcinoma of the uterus. Suggestive arrest of the progress of the disease under fetal emulsions. These were discontinued and injections of atoxyl, sodium cacodylate and intravenous injections of metallic colloids substituted for a time. Apparently the patient has done as well upon the latter treatment as the former. Finally it is evident that the patient is slowly but progressively failing.

CASE 19.—Mrs. N. Age 40. Carcinoma of the sigmoid. Colostomy and attempted extirpation which could not be completed on account of the patient's condition. Slow but progressive failure. No apparent influence from injection of autolysates. Increasing cachexia.

CASE 20.—Mrs. B. Neglected carcinoma of the breast treated by osteopathic manipulations. Very extensive removal followed one month later by secondary

nodules in adjacent skin along the axillary vessels above the clavicle, not restrained by vigorous employment of X-rays. Injection of Fichera autolysate. Treatment discontinued. Disease progressing.

CASE 21.—Age 66. Carcinoma of the bladder, of slow evolution. Improved after fulguration and medical treatment. No distinct influence from injection of small quantity of fetal products. Treatment not properly continued.

SUMMARY

First.—Homogeneous emulsions or autolysates prepared from human fœtuses or embryos have, in our experience, shown no distinct value in the treatment of malignant disease in man.

Second.—Spontaneous or inoculated tumors of rats and mice are susceptible to various forms of treatment, and in this way differ from malignant tumors of the human family. Experimental evidence derived from tumors in the lower animals is, in many instances, misleading and valueless as applied to human practice. The favorable effects reported from novel or unusual methods of treatment for malignant disease usually result from the enthusiasm and hope attending their introduction.

A METHOD OF INTENSIFYING NATURAL ELEMENTS IN THE TREATMENT OF TUBERCULOSIS UNTIL THEY BECOME THERAPEUTIC AGENTS

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I FOUND, in experimenting with X-ray in 1901-2, in the treatment of cancer, that great tissue changes took place, not only in the cancerous tissue but in the healthy tissues as well. This was more beautifully demonstrated in the treatment of breast cancer than elsewhere, for the small, shrivelled, ulcerating breast, where treated with X-ray, would become as large again as its fellow of the opposite side, due entirely to the hypertrophy and engorgement of the tissues. It was also noticed that the X-ray had quite an analgesic and anodyne effect. It was at this time considered that X-ray produced its effect on cancer cells by overstimulating them to the point of producing their death.

So, my first reasoning, after the accidental raying of a tuberculous mass in the abdomen, and noting the effect, was, that if tuberculosis was a disease of impaired nutrition or lessened blood-supply, why could not this agent be used to stimulate the tissues and increase the blood-supply and nutrition, and in so doing aid Nature to hasten fibrosis and repair the damage in tubercular conditions? Fortunately, the first few cases in which I used X-ray improved in such a remarkable manner as to completely enthral me with the result, and many such results have come to me in the management of several hundred cases. My excuse for writing this paper is the hope that it will aid and stimulate other physicians to take up the work and help me develop and prove that in these agents we have a specific for tuberculosis. After I had been using these agents for some years it occurred to me that I was only using, in an intensified form, the natural elements that are paramount in the high and dry climatic resorts where patients are usually sent when a change of

climate is desired, so I have styled the procedure as "Intensifying Natural Elements Until They Become Therapeutic Agents."

Almost every X-ray operator can claim success in treating the various forms of tuberculous cervical adenitis, certain joint affections and tuberculous glands of the abdomen, etc., or, in other words, localized conditions. Pulmonary tuberculous conditions are not usually localized, but are constitutional or systemic conditions, and therefore more complex in their management; therefore I will devote myself entirely to pulmonary tuberculosis.

Probably the first thing in the treatment of pulmonary tuberculosis is for the physician to be familiar with the disease and know how to manage the patient so as to get the very best out of the hygienic, dietetic, and medicinal handling of the case. We know that Nature cures a great many cases of tuberculosis, even unaided, so intelligent help should cure many more; therefore, from a strictly hygienic standpoint, there is much to be looked after. I do not believe in the necessity or the advisability of tent or sleeping porch, nor needless exposure to the elements. The sleeping porch and tent have been disastrous to me in my personal work, and with my method of treatment I can say unhesitatingly that we do not need them. Of fresh air we need an abundance—the purer the better—but it has never cured a patient by itself, and thousands have contracted the disease who lived in country homes (in the warm countries especially) where foul and vitiated air is unknown, so it is not necessary to jeopardize the life of your patient by trying to harden him to all kinds of weather. I would rather have a large room with four windows, one or two doors, and capable of being made comfortable when necessary, than any sleeping porch. The patients should be required to dress warmly and comfortably, and should be kept comfortable day and night. When confined to the bed the room should be kept scrupulously clean, the windows well opened, so the wind can blow through, and the room kept well ventilated—the room should never be kept hot. I always like a cold or cool room and let the patient use necessary cover and clothing to keep warm. I want a room that can be constantly flooded with sunshine, as sunlight is the great life-giving factor in tuberculosis, and poor indeed is the tubercular invalid who must be deprived of it. The feeble patient should not only be bathed daily but also sponged with alcohol.

Diet.—Few physicians and tubercular patients appreciate the importance of this heading. I sometimes think it is the axis around which the whole problem of success revolves. The physician who can have his patients eat the most and digest the best certainly has a great deal in his favor in the contest for success. I believe in a rich nitrogenous diet, based on meats, eggs, milk, bread and butter, etc.

Medicines.—In my method of work scarcely any, excepting to meet and palliate symptoms—and these are mostly remedies to aid digestion—support the heart and relieve the cough, etc. Pepsin, pancreatin, and the bitter tonics are used as needed to aid the stomach in digesting its full capacity three times at least daily; the bowels are managed so that each individual patient gets the greatest amount of nourishment from his food; the cough is controlled by ether, morphine, codeine, heroin, or dionine, mostly the latter, unless there is danger of hemorrhage, or the cough is unusually severe. The X-ray has special virtues in this line, which we will discuss later.

Heart.—The heart requires much attention with this disease. In almost every case, even before a rise of temperature is noted, the pulse is found weak and fast, and my own experience is that the blood-pressure is invariably below normal—so much so that very low and continued low blood-pressure should excite suspicion of tuberculosis. I think few cases of this disease but will bear strychnine well and advantageously. Digitalis, ammonia, and most of the heart tonics can be used at some time with advantage. Electricity is of great service in supporting and strengthening this organ, and I use it constantly for this purpose.

Rest.—This in many cases is an exceedingly important factor; frequently the physician must play dictator to have this factor carried out properly. I believe a laxity on this question has caused me more failures than anything else. In acute febrile cases it is imperative. It husbands the patient's strength, aids his digestion, aids his nutrition, removes strain from the heart—all necessities for the recovery of the patient. A time comes, however, with every successful case, when exercise must be allowed. Here comes the danger. The better the patient feels, the stronger he appears, the greater danger of his doing some foolish thing that is liable to ruin him.

Vaccines may be used with some success, but in the majority of cases success is only temporary. Tuberculin, in properly-selected

cases, may be used with undoubted benefit, probably in early cases, etc., but is of *no* use, and dangerous, in serious or fulminant cases. Neither of these agents is often needed in my method of work.

On the foundation briefly set forth we come to a description of the agents in our special method of procedure.

X-RAY—INTENSIFIED SUNLIGHT

In the term X-ray are included five and one-half octaves of ether vibration, or, in other words, a range of vibratory rays more than five times as broad as those that are seen or comprehended by the human eye. When you think of each of these five octaves having qualities all their own you can begin to grasp somewhat the different therapeutic possibilities there are in the term X-ray. Sunlight is the greatest foe to tuberculosis in the physical and organic world as well, so I have come to the conclusion that this light, intensified millions of times as we have it in the X-ray, is the greatest foe to the germ of tuberculosis in organized tissue we possess to-day.

When I first began the use of X-ray in treating pulmonary tuberculosis my idea was to give just enough X-ray to produce a hyperæmia of the diseased lung tissue, and thus, by the increased blood-supply and the nourishment to the tissues, combined probably with an inhibitory effect on the development and well-being of the bacilli, to help the tissues fight a winning fight with the disease. Now to this reaction and attendant engorgement we claim there takes place a decided inhibition in the development of the bacilli: some are so weakened that death soon takes place, while others probably die from the direct effect of the rays, but probably others are attenuated and their virility destroyed, giving us a harmless germ, similar to Webb's attenuated bacilli, or the turtle or cold-blooded animal bacilli; anyway, when this result or combination reaches the blood, and then lymph streams through the body for removal, it is immediately attacked by the leucocytes, probably by the large mononuclear mostly, but in the process of liquefying and digesting these bacilli by the leucocytes their toxins are eliminated or brought in contact with the blood stream, and Nature must necessarily furnish amboceptors or antitoxin to neutralize these toxins, or the patient will rapidly succumb. This process, I claim, gives us the finest imaginable autog-

enous vaccine for our cases. McCullough, of London, and Crane, of Michigan, both claim to have been able to prove that by means of X-ray a constant positive phase of the opsonic index can be maintained in tuberculosis, which is the most favorable condition possible, according to Wright and Douglas. Another effect of the X-ray which I have not heretofore cited is what we will call the squeezing or contracting effect. This is illustrated in the treating of tubercular glands or in large carbuncles. It is possible, in these cases, in fifteen minutes, to squeeze or contract these tissues to almost half their size—at least, reduce them perceptibly almost at once. These cases go on to a cure. Can we by this contracting power of the X-ray force these bacilli out of their hiding places, directly into the circulation, or somewhere where they can be reached by the leucocytes and destroyed? In the squeezing-out process, are these bacilli so weakened and vitiated by the ray as to make them especially easy of destruction by the leucocytes? As we have never noticed any untoward effect from the X-ray under these conditions, this would be in keeping with much favorable experimenting that is being done now with the vaccines or serums containing the living attenuated germ.

In closing this fascinating subject I will say to our bacteriologic friends that to make their vaccines and serums a complete success there is an element they need and have not found. I say, with X-ray in tuberculosis, also in healthy tissue, blood, and spleen, we have found an element which we do not thoroughly understand, and hide our ignorance under the name of toxin and antitoxin, and it is this element I consider the capstone in the arch of a specific for tuberculosis, whether it is produced by the X-ray, or whether finally wrung from the bacteriologic laboratory. It must be remembered in all X-ray treatment that the idea is to produce a reaction in the diseased tissue and also in the adjacent normal tissue, and the dosage to obtain this reaction is the *real* secret of all X-ray treatment.

ELECTRICITY

This I consider the most important auxiliary to X-ray in the treatment of tuberculosis. The method I prefer is the Brush discharge from the static machine. This is what I like best ordinarily, but other forms will have to be substituted occasionally; but as a

routine measure I prefer the Brush discharge, given over the upper spine and shoulders, paying especial attention to the sites of old and other pleurisies. An effort should be made to relieve all pain, if any exists, at each treatment. I have reached the conclusion that more beneficial results can be obtained in stimulating the stomach to increased action from electricity than from any other agent. The effect of the Brush discharge is especially useful in the heart condition of these patients. I find that my patients stand the X-ray better and the skin is less affected by the rays when I use the Brush discharge, so, saying nothing about the metabolistic effect, the soporific, the eliminative, and anodyne effects, we are bound to admit that it has attributes which force the recognition of its value in these cases. It is one of the attributes of dry climates like Colorado, and with a static machine can be intensified to any point desired. I usually use it every other day, alternating with the X-ray. It is used usually for about ten minutes at each séance, or until the palms of the hands become moist, as a routine procedure.

OZONE

This measure has been much extolled in the treatment of tuberculosis for many years. I think it is of undoubted value—less, perhaps, however, than either of the other agents, but useful, nevertheless. I use it, passing it through a nebula of menthol, camphor, eucalyptus oil, pine-needle oil, and argyrol and liquid petroleum. This mixture is nebulized through a compressed-air machine and forced through the ozone generator, where it mixes with the ozone in the proportion of one to three atomic weight without any chemical changes, thus giving an ozonized nebula, which is inhaled by the patient with moderately deep breathing every day. The only care required is to watch for bronchial spasms.

TECHNIQUE OF ADMINISTERING X-RAY

X-ray is usually given three times weekly, on alternate days with static electricity. We want the ray generated by a machine that is capable of furnishing the ray with good volume of output, not altogether rays as swift as the late-day skiagraphic ray, but a ray that

will take the skiagraph of the ordinary tubercular lung in from one to two minutes with about one to two milliamperes flowing through a large tube for some ten minutes, the tube being within 14 to 18 inches of the patient's chest (owing to the perfection of the ray used). The patient is treated one day on the front of the chest, the next time over the back of the chest. Care must always be taken to watch effects of the ray on the skin, and the distance of the tube regulated accordingly; of course, the patient's head, face, and genital regions must be covered with lead or other protective agents. Remember that we are treating for the express purpose of bringing about specific reactions, but that we want them in the lung and deep tissues of the body, not in the skin. The usefulness of the X-ray depends entirely upon the correct dosage with which it is given, and herein lies the whole secret of the success of the treatment: if your dose is too small, you do no good; if your dose is too large, you do harm in different ways, throwing too much débris into the circulation, injuring the kidneys, producing toxæmia, endangering the skin, and making your patient miserable. But, to be effective, the reaction must be maintained, as it is the reaction of the tissues, normal and pathological, respectively, through the X-ray, which produces the cure or beneficial effects—therefore the ideal should be to use the X-ray in such a manner as to try and keep the opsonic index in a continual positive phase. This is the difficult part of the work; it will vary with different patients on account of their respective resistances; the type and kind of machine giving the value to the ray will vary, so each individual case will have to be watched and treated according to its own requirement. I consider the X-ray as having attributes of special advantages of its own in the treatment of pulmonary tuberculosis, for:

First.—It prepares, you might say, a field on which to fight the battle with the germs. It does this by drawing large quantities of blood and nutriment to the diseased parts, by virtue of its own irritating and stimulating properties; thus the hyperæmia and engorged tissues are more able to cope with the bacilli, living or dead.

Second.—There is nothing else of a remedial nature that can enter the enclosed or encapsulated tubercle and destroy or inhibit the multiplying of the bacilli in the encapsulated tubercle like X-ray. The blood-supply is cut off, does not reach the inside of the encapsu-

lated or enclosed tubercle, so how can any blood-carried specific or serum have any effect on this class of tubercle? X-ray penetrates these tubercles encapsulated, enclosed or otherwise, just as it penetrates bones, and with its death-dealing power inhibiting propagation of the bacilli, weakens and finally destroys them. This effect on the tubercles I consider one of the most important effects of the X-ray in this disease, as it lessens the chances of new invasions of the bacilli in the future, and therefore the patient is more free from relapses. This enables me to claim that a patient with sufficient X-ray should never die of tuberculosis.

Third.—In previous papers I have intimated that the X-ray should probably be laid aside for tuberculin in incipient cases of pulmonary tuberculosis. I wish to rectify this statement, as we find that from 65 to 70 per cent. of all pulmonary tuberculosis originates first from infections of the bronchial and mediastinal glands, and spreads from them, usually first to the apices, and then, fan-like, over the upper lobe of the lungs. When we remember how effective X-ray has proven in tubercular cervical adenitis, why should it not be equally effective in the bronchial glands and thus abort the pulmonary tuberculosis, which I believe can be done, and will be really the great prophylactic measure of the age?

Fourth.—The prophylactic effect of treating these glands with X-rays is of transcendent importance. How can we expect to cure a case of pulmonary tuberculosis, and have it remain cured, when the original foci of infection is left behind? So long as these glands harbor bacilli, will they not continue to pour them into the lungs? Is this not the great cause of recurrent attacks? Every Röntgen operator claims X-ray can cure and will cure tubercular glands; then why should it not be used on bronchial glands, by all means, even in incipient, doubtful, or suspicious cases?

I will briefly summarize the effects of X-ray as I find them to occur in the treatment of pulmonary tuberculosis. These effects take place in a most direct manner in the vast majority of cases, and is really my basis for claiming a specific in this method of treatment for pulmonary tuberculosis.

First.—An engorgement or hyperæmia of the lungs.

Second.—The number or quantity of râles is temporarily increased.

Third.—The cough is ameliorated by loosening and liquefying the sputum, making it easier of ejection.

Fourth.—Aids the gradual reduction of temperature.

Fifth.—Relieves pleuritic and muscular pains and soreness of chest.

Sixth.—Improvement of the well-being of the patient, as shown by gain in weight, slowness of pulse, improvement in digestion, etc.

Seventh.—Shortness of breath will be increased in advanced cases, due either to the toxin or to the pulmonary congestion.

Eighth.—During the third month of treatment ordinarily there will appear, in advanced cases, white flecks of sputum mixed with yellow. The white increases and the yellow decreases until the white supersedes the yellow entirely.

Ninth.—Usually during the third month in ordinary cases the râles begin to disappear, and I count on the lungs being clear by the end of the fourth month.

Tenth.—The X-ray has more influence on the second- and third-stage cases than on incipient or cases of very slight involvement. The reason of this is that autogenous vaccines are readily produced by the rays where there are large areas of germ-infected tissues to contend with, while in the slight, incipient cases it is difficult to make a vaccine, and one must depend upon mechanical effects entirely, which can probably be aided by tuberculin.

Eleventh.—Any case that has vitality sufficient to react to the influence of the rays and furnish amboceptors or antitoxins, thus completing the vaccine formation in the blood and tissues, is susceptible to improvement by the use of the rays, with proper dosage, nursing, food, and care. I have seen more than one patient almost raised from the dead.

Twelfth.—It is not dependent upon circulation, but penetrates all tissues, bones, muscles, etc. It also penetrates the tubercles, old and young, with its inhibiting effect on bacilli—something that can be accomplished by no other agent.

Thirteenth.—X-ray is only intensified sunlight, and you can put more light through the lung in ten minutes with the X-ray than you will get in a month of sunshine.

These are some of the conclusions that I have reached from observing something over four hundred cases, forty-six of whom are

dead from various causes; the balance are alive at this time, and the vast majority of them are bread-winners. By far the larger percentage were advanced second- and third-stage cases. At the present time many of these cases do not react to tuberculin, nor can bacilli be found in their sputum. The great trouble I find in getting an absolute, and you might say perfect, cure is that the majority of the patients, when they get well enough to work, having been idle so long, *will* return to business, they consider themselves well, and cannot be prevailed upon to continue treatment until perfect results are obtained. The vast majority of the patients, after being dismissed completely and returning to work, have returned to their homes in the East, North, and South. Three of these have returned for treatment, one of whom died; the other two are back at their homes and at work to-day.

In closing this paper I want to emphasize the fact that the patients who recover from this method do *not* relapse or have a reinfection to anything like the extent of patients treated simply by climatic, hygienic, and dietetic methods.

THE CONTINUOUS WARM-WATER BATH THE RATIONAL REMEDY IN TUBERCULOSIS (PHY- MATIASIS) AND INFECTIOUS DIS- EASES IN GENERAL

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To understand the reason why the continuous warm-water bath is the rational remedy in phymatiasis it is necessary to find out and learn the manner in which it acts, eliminating the products of inflammation and infection through the circulation.

History is logic, and history will give us this understanding.

Paulus of Ægina, who lived in the seventh century under Heraclius, the Byzantine Emperor, had those of his patients who had been operated on for hernia, especially children, submersed in warm water for seven consecutive days after the operation, in order to prevent inflammatory symptoms.

The introduction of this method to eliminate the products of inflammation has erroneously been ascribed, by some, to two German surgeons, Fritz and von Walther, and by others to Baudelocque, the great French obstetrician, who lived during Napoleon's time and who made use of the continuous bath in cases of peritonitis. His method was revived by Noeggerath in the German Hospital of New York, but abandoned again after Noeggerath's departure.

While reading medical history I learned that Beaupré, whose memory is associated with the history of Napoleon's campaign in Russia, had made use of the continuous bath in surgery, but in vain did I search for a detailed description. Stromeyer (1804-1876) placed his patients operated on for vesicovaginal fistula in the continuous bath. Langenbeck introduced the method in surgery in the year 1850; characterizing it as the mildest, not requiring dressings, securing clean wounds in a manner which could not be surpassed by any other method.

In the treatment of wounds it is an aseptic, and to some extent it may be an antiseptic, at least in some cases. Billroth, in the Zürich Hospital, treated 277 cases with the continuous bath and

thought it the most powerful means to keep the inflammation within the desired limit. In the year 1870 appeared *Max Schede's* treatise on the treatment of injuries of the hands and feet by means of the continuous bath. This excellent treatment was introduced by Dr. Glueke and myself in the St. Francis Hospital of New York, and it is yet the best of all in many cases of wounds of the hands and feet caused by crushing machinery. The specific action of the continuous bath we can study when we learn of its effect in cases of burns. Here we see plainly its action on innervation and circulation, which interests us more particularly in connection with its peculiar quality of eliminating tubercle bacilli.

On September 14, 1857, Dr. G. Passavant, of Frankfort-on-the-Main, treated 13 cases of extensive burns by placing the patients in the continuous warm bath, using, according to the extent of the injury, the partial or the full bath. And this is the first record I can find in literature of the treatment of burns by the continuous warm-water bath. His classical publication on this method appeared in the year 1858. Strange to say, it was named after Hebra, who first made use of it in the year 1861, and who wrote in the *Allgemeine Wiener medicinische Zeitung* (1861, No. 43): "The continuous full bath, given for therapeutic purposes and kept up for days, weeks, and months, has, so far as I am aware, never been tried or carried out by any one." And I have never seen Passavant's name mentioned as the one who introduced the method.

The action of the continuous bath in burns is manifold. It gives almost immediate, and even complete, relief from pain, and can be regarded as the most excellent anodyne. Even if it offered no other advantages, it would be of great value on account of this soothing effect when the pains are most excruciating. Another advantage of the warm-water treatment is that the water penetrates the burnt tissues, in consequence of which they remain moist and soft. Without the immersion the cuticle which has been destroyed in its whole depth would harden and form an impenetrable covering over the underlying parts. Immersed in water, tissues which have become gangrenous cannot dry up, but remain moist. They detach themselves easily and are washed away after having become detached. Thus the wound is constantly kept clean. There is no accumulation of pus, there are no crusts of desiccated wound secretions, and, most

essential, no dressing is required. The patient has not to suffer the often painful process of change of dressing. The most essential advantages of the continuous bath in cases of burns are those which we understand from its physiological action on circulation and innervation in general. The principle in using the continuous warm bath is to eliminate the products of inflammation and infection.

The warm bath, in surrounding the surface of the body with an equally-tempered medium, does away with fluctuation of the loss of heat, and thus acts soothingly. The thermic irritation of the peripheric nerve-ends, while it lessens the sensation of pain, calls forth at the same time, by way of reflex action, especially in the muscles, an increased metabolism. The fatigue or exhaustion of muscles is caused by a supernormal accumulation of the products of their function. To oxidize and eliminate these products a certain amount of metabolism is required. The specific effect of the warm bath is to afford immediate facility for oxidation. The changes of the physical and chemical conditions of the tissues, the augmentation of the organic function, the acceleration of the blood circulation, the dilatation of the blood-vessels all depend on the specific action of the continuous warm bath on innervation. When a part of the body is placed in warm water, the nerve-ends of the skin become irritated. This irritation is transmitted to the vasomotor nerves, and is followed by dilatation of the blood-vessels and, consequently, by an acceleration of the circulation. This accelerated blood circulation facilitates the elimination of the products of inflammation and infection, and, with the removal of pyrogenous substances and toxins through the general circulation, the fever will be reduced. The warm bath is, as we shall see, a means to stimulate metabolism.

When reading history or studying ethnography we feel horrified upon learning of barbarous cruelties, but nothing can surpass medical cruelty when cases of extensive burns are treated with all kinds of dressings instead of resorting to the most rational, the ideal method of placing the patients into a warm bath. I happened to see a patient with extensive burns in excruciating agony, with facies hippocratica, in one of our public hospitals, whose wounds were being dressed by two nurses. I spoke to the physicians in attendance, suggesting the bath to relieve at least the frightful suffering. They had

never heard of such treatment and refused to follow my suggestion. There are certainly many cases which without the advantage of this means would prove fatal, while with the aid of the continuous warm bath they make a good recovery.

Conclusive evidence that the continuous bath eliminates the products of infection and inflammation is furnished in the treatment of erysipelas of the trunk or the extremities. We place a patient, or the erysipelatous part, in the continuous bath and within a few hours the temperature is reduced; within a day or two it becomes normal, and all symptoms of erysipelas are gone. I beg to refer to my description of such cases published from time to time ever since the year 1888.

Of the effects of the continuous bath in cases of arthritis, especially rheumatic arthritis, I need not speak here in detail; they are too well known. I will give only the explanation of the action of the continuous bath in all those affections thus far mentioned in this paper.

An arm suspended in the continuous warm-water bath increases in volume; this occurs simultaneously with the pulse-beat, and is caused by the large amount of blood driven into the arm with each systole of the heart; there are also changes of volume which correspond with the larger amount of blood passing out during the interval between two systoles. By means of an ingenious apparatus invented by Winternitz we can measure this increase and decrease of volume as well as the increased amount of blood passing into the arm with each systole and the correspondingly larger amount of blood passing out of the arm during the intervals between two systoles.

The power of the continuous bath of eliminating products of infection can further be demonstrated by its application in cases of cerebrospinal meningitis. The literature concerning serum treatment in this disease has assumed formidable dimensions, and the enthusiasm over this new method is so great that it appears to be a bold undertaking to speak of another remedy in place of the anti-meningitic serum, as it is called. However, the enthusiasm may subside and the rational and safe remedy, which we have in the continuous bath, may be considered. Thus far the text-books hardly mention it, and one of the most quoted writers says: "Baths are useful, but difficult to employ, because the patients are obdurate and

suffer considerably during the manipulation." This is the direct opposite to the observations actually made with the continuous warm bath in the treatment of cerebrospinal meningitis.

During the years 1871 and 1872 cerebrospinal meningitis was epidemic in New York. I was at that time attending physician at the St. Francis Hospital of that city and had in my ward twelve cases of this disease. Our experience was that medicines like iodides, bromides, or morphine, which we prescribed for a while, seemed to have no perceptible influence on the course of the disease, nor even on the symptoms. We were well satisfied, however, with the effect of the continuous warm bath. Strange to say, in recent literature its introduction into the therapeutics of cerebrospinal meningitis is ascribed to Aufrecht, and the year of its first employment is said to have been 1894. All the twelve patients whom I treated with the continuous warm bath, to the exclusion of medication, recovered, and the explanation of this result we find in the physiological action of the continuous warm-water bath. The continuous bath is the rational remedy in case of cerebrospinal meningitis on account of its clinical effect on the nervous system in sickness.

The following observations were given by the late Dr. Dent, Medical Superintendent of the New York State Hospital on Ward's Island: In acute maniacal conditions or acute delirium states, characterized by great motor activity, the prolonged warm bath has proven very efficacious. It not only decreases the motor activity, but after some time in the bath (that is, some hours) it produces sleep. In some cases of insomnia great benefit was found in this way without the use of sedatives.

In acute delirious conditions, characterized by great malaise, restlessness, and increased temperature, the following results have been noted: The restlessness as well as the temperature has been reduced. This is undoubtedly due to the stimulation of metabolism, as the bowels are more active and become regular. The movements are generally loose. The urine is increased in amount. We often find that tactile hallucinations are relieved. We have also noted an increase in the appetite, the patient taking food better and receiving more benefit from the food.

The length of time required in the baths varies. Some patients become quiet after a few hours, other cases require a longer treat-

FIG. 1.



Patients under treatment in the continuous bath. (Photograph made through the kindness of William Mabon, M.D., Superintendent and Medical Director of the Manhattan State Hospital, Ward's Island, New York City.)

ment. In maniac depressive cases it is not unusual to have a patient in the prolonged bath for four or five days, or even weeks. This form of treatment is not distasteful to the patients, very few, as a rule, objecting to it after once becoming familiar with it. In fact, some patients, after removal from the tub, have requested to be taken back.

Dr. Dent's successor, Dr. Mabon, spoke on the continuous bath as follows:

"The disturbed insane have hitherto formed one of the most difficult groups of cases to treat successfully, but with the introduction of the continuous bath we now cure approximately 95 per cent. of acute maniacal conditions. The patient lies upon a canvas sheet in a large tub, through which the water is constantly flowing at body temperature, and here a patient will sleep when unaffected by ordinary hypnotics. It may be said that scarcely any form of excitement exists but that is not favorably influenced by this treatment. Of course, in senile patients with arteriosclerotic changes and in individuals suffering from gross cardiac or pulmonary lesions, care must be exercised, but even such patients undergo a prolonged bath treatment much better than might be anticipated, and with benefit as in no other way. Indeed, such patients show less adverse symptoms than was formerly the case when their excitement was controlled by powerful hypnotics, with their attendant depressing effect upon the cardiovascular and muscular systems. Maniac depressive excitements are thus favorably influenced, although they usually respond less promptly than do the infective exhaustive and toxic conditions, in which improvement is usually shown within twenty-four to forty-eight hours. In fact, this form of treatment is now regarded as absolutely essential in the care of the latter. By means of the continuous bath it may be said that the use of hypnotics has been largely reduced, and drugs are never used as a substitute for the prolonged bath." (Fig. 1.)

From all this we perceive that there are two explanations for the beneficial effect of the continuous warm bath in cases of cerebro-spinal meningitis: its power to eliminate products of infection and its beneficial effect on the diseased nervous system. Many details with illustration by case histories will be found in my book "*Carbonic Acid in Medicine*," in which I have devoted a chapter to the continuous bath.

With all these observations of the action of the continuous bath in cases of burns, of erysipelas, of arthritis, of cerebrospinal meningitis, of mania, before us we can easily understand its indication in phymatiasis.

Seven years ago I was called to a distant country town in consultation in a case of spondylitic phymatiasis. The patient had at first suffered for years from pulmonary phymatiasis, but, as it appeared, an intervening valvular disease of the heart, causing pulmonary stasis, had been the means of arresting the tuberculous process in the lungs, and then spondylitic phymatiasis had developed. There had been necrosis of one of the vertebræ, and consequently kyphosis was present; no paralysis of the lower extremities nor of the sphincters. The patient was unable to rise, he suffered great pain, was feverish, and his general condition was deplorable, being complicated with gastric disorder.

I entertained no hopes as to a final recovery, but in order to give relief I ordered the continuous warm bath, which was kept up twenty-four hours every day for over a month. The next time I saw the patient, from whom I had not heard a word, I was much surprised. He had come from his country town to my office in New York City without any truss, without any support, without even a cane. I need not enter into details, because it is an established fact that phymatiasis of the bones and joints is a disease in which the continuous bath affords triumphant results. All I have to say is that I cannot understand why it is almost unknown among the surgeons of New York. In order to explain why in this case the pulmonary phymatiasis was arrested let us consider the part which is played by carbonic acid in arresting the development of tubercle bacilli and other infectious bacteria,—that is, the principle of Bier's theory.

It is well known that lungs overcharged with carbonic acid, as in the case of emphysema, enjoy a certain degree of immunity against the attacks of the tubercle bacillus, and it has been assumed that the carbonic acid in our system protects the tissues from invasion by tubercle bacilli. In support of this theory a number of facts have been mentioned, among which may be instanced that diabetics are especially prone to phymatiasis; this is due to insufficient development of carbonic acid.

According to Ebstein, imperfect development of carbonic acid is a factor in the causation of diabetes. The frequent association of diabetes and phymatiasis justifies the conclusion that Ebstein's tissue anomaly furnishes simultaneously favorable conditions for the development of phymatiasis. We have also to consider the weighty circumstance that, while there is insufficient combustion of sugar, the formation of carbonic acid in the system must be reduced by one-half, thus forming a *circulus vitiosus*. This view of the interference of carbonic acid with the development of phymatiasis is supported by other generally known facts, which, however, have not yet been regarded from this standpoint. Phthisis is arrested during pregnancy, although one would think, according to physiological conceptions with which we have been made familiar, and by the increased demands made on the sick individual, that the contrary should be the case. With the aid of our theory, however, we can comprehend it and find it even natural, when we consider the following fact: The fœtus continuously introduces carbonic acid, by metabolism, into the maternal organism, and it is this carbonic acid which checks the murderous disease.

Patients with heart-disease and considerable venous hyperæmia of the lungs,—i.e., the lungs overcharged with carbonic acid,—enjoy a certain degree of immunity against phymatiasis. On the other hand, children born with stenosis pulmonalis die invariably from phymatiasis, because the afflux of venous blood to the lungs is imperfect.

In regard to the mucous membranes, we find that wherever there is greater vascularity, and consequently more active metabolism, more carbonic acid is produced, and this means better protection against phymatiasis. The mucous membranes of the mouth, pharynx, and œsophagus are less vulnerable in regard to phymatiasis than those of the larynx and trachea, while the stomach, dodecadaetylon (duodenum), bile-ducts, and urethra are almost immune. In other parts—external skin, muscles, cartilages, bones, serous membrane—the relation to phymatiasis depends on the amount of carbonic acid they contain.

That tubercle bacilli cannot thrive where an excessive amount of carbonic acid is present can be illustrated by Bier's method for the cure of phymatiasis of the bones, and by the success of Dettweiler's

method of a continuous recumbent position of the body, when venous blood, or, what is practically the same thing, carbonic acid, will accumulate in the lungs. The fact that laborers in limekilns remain immune against phymatiasis is explained by the circumstance that in their case the diffusion of gases is made more difficult, elimination of carbonic acid being to a certain extent prevented.

Mrs. D., of a healthy, long-lived family, mother of healthy children and grandchildren, became ill about six months before I saw her on March 13, 1912. From the history given I learned that she had been coughing and had been feverish. The temperature had never been taken. There was a painful cough with expectoration; temperature in the axilla 101° ; the sputum contained many tubercle bacilli. The diagnosis thus being made, the patient was placed in the bath on March 20. Her temperature, measured in the axilla, was at that time 99.6° F.; the temperature of the water was 98° F., but in the course of time the patient preferred a lower temperature, about 96° F. According to the report of the nurse, the patient passed a comfortable night, and slept well; her temperature was 99° F. at 11.15 P.M., and 97° F. at midnight. From the time she was put in the water she felt well in every way except for some discomfort due to the imperfect arrangements for support by a hammock, which were remedied the next day. Her appetite was excellent, much better than it had been before. All functions were in perfect order, bowels quite regular, urine voided in very large quantities, as is regularly the case, and as can be explained physiologically. The temperature during the first days varied from 98° to 99° F.; on March 30th and 31st and on April 1st it was normal. On March 30th I took the designer of the bathtub with me to see if he might suggest some improvement in the arrangement of the couch in the bath and the mode of securing constantly running water from the kitchen range. His suggestions were to be followed on March 31st, but when I made my visit on that day I saw no room for improvement in the condition of the patient. Examination of the sputa showed no more tubercle bacilli.

The next case of treatment with the continuous bath was that of Mr. K., 32 years of age, who had been a patient in Seton Hospital from August 21, 1911, to April 12, 1912. Infiltration of both lungs,

especially the left, was present. From the history I learned that he had been suffering from pulmonary trouble since the year 1907. The hospital report says: Left pars antica, dull above clavicle; pars posterior, dull above scapula; râles comparatively dry, crepitant and subcrepitant; right pars antica, dull above clavicle; pars posterior, dull above spine of scapula, an occasional râle above and below clavicle. Breathing sounds exaggerated over upper lobe; high-pitched inspiration and prolonged expiration.

This patient was in the bath continually from April 15th to May 8th,—that is, 23 days; and out of the water three days, and again in the bath for 32 days—altogether, in the bath for 58 days, all day and all night. Except during the first and second days, when gastric symptoms set in, and on the second and third days, when the feet became painful, the patient felt comfortable in the water; his appetite and all functions were perfectly normal, he slept well, and was satisfied with the treatment. The sputum was examined every week. The number of tubercle bacilli in the field, which had been from six to seven, became reduced to one to two, but they did not disappear entirely. There had been slight elevation of temperature before the bath was taken, but this became normal and remained normal.

Upon the whole, the patient's general condition had improved; his weight, which had been 105 (he is a man of small stature), increased to 110 pounds. Remarkable was the improvement of his appetite, and this improvement has continued until the present time. The physical symptoms of the lungs have not changed much. This case demonstrates that, even in advanced phymatiasis, in cases of long standing the bath is well tolerated.

The next patient was Miss B., 27 years of age. General phymatiasis from childhood. Had had hip disease, which left a slight deformity and slight shortening of the left leg. Infiltration of both lungs, especially the left. Patient had been in the German Hospital of Brooklyn, N. Y., from February 27 to March 29, 1911. The hospital report reads: Chief complaint, enlarged glands of the neck, right side; present for five years. About two months ago some enlargement appeared on the left side. Physical examination shows left lower chain cervical glands involved and right upper chain.

On March 1st Dr. Russel S. Fowler excised left lower cervical chain, and on March 13th right upper cervical chain. After-course uneventful.

This patient was in the bath continuously, with an interruption of three days, in intervals of one day at a time for five weeks. With the exception of some gastric trouble on the second day and pain in the feet on the second and third days, she felt very comfortable in the water. Her appetite improved, all functions were perfect, and she gained five pounds in weight. While at first there were found 60 to 80 tubercle bacilli to the field, there were only 1 or 2 finally, but the bacilli did not disappear entirely. The swelling of the cervical glands, which had remained or become enlarged after the operation, has almost entirely disappeared.

Neither of these two patients has been entirely freed from tubercle bacilli, but their general condition has improved remarkably, and both are well assured that they have been greatly benefited. They regret that, on account of circumstances over which they have no control, they could not remain in the water still longer.

The description of the arrangement for the continuous bath is fully given, with illustrations, in my book "Carbonic Acid in Medicine." It is the description of the continuous bath used in the Manhattan State Hospital and other phrenocomeia. The arrangement which I had to make in the last two cases here described—the patients living in tenement houses—was simply that by means of a rubber hose I made a connection with the faucet of the kitchen range for running hot water.

Medicine

PAROXYSMAL HÆMOGLOBINURIA: ITS RELATION TO SYPHILIS, ESPECIALLY IN THE LIGHT OF THE WASSERMANN REACTION

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THE clinical phenomena of paroxysmal hæmoglobinuria have been investigated with great care by many observers, so that it is not proposed to enter here into any minute details on that aspect of the subject. It is sufficient merely to give a brief outline. Thus certain rare individuals, otherwise usually in fairly good health, are liable to excrete in their urine at times hæmoglobin more or less altered. There may be found in the urine along with the hæmoglobin also red blood-corpuscles, but these are quite inconsiderable in number as compared with the large amount of hæmoglobin which is present (urine dark red or brown). The hæmoglobinuria is transient (paroxysmal), but tends to recur. Urobilin appears in the urine. Albumin may be present in the urine for a variable period after an attack; it may precede the hæmoglobinuria, or it may appear when hæmoglobinuria might have been expected to occur. Jaundice may follow the attacks. Although tube-casts may be found in the urinary sediment, there is in general no evidence that nephritis exists. In most subjects the attacks are precipitated by cold, but the duration of exposure and the degree of chilling necessary to determine an attack vary greatly in different cases and also in the same case at different periods. The first attack may occur at any age. In many instances it follows very severe chilling. Subsequently the

attacks are usually more and more readily induced, and tend to recur at progressively shorter intervals and to be of increasing duration. Certain symptoms precede the hæmoglobinuria, most usually shivering and sensation of cold and Raynaud's phenomena. Other prodromal symptoms are headache, oppression in the region of the loins, yawning, drowsiness, and unconsciousness. The hæmoglobinuria follows after a variable time (ten minutes to eight hours in our series of cases). There is practically always fever, which may be preceded by a subnormal temperature. Certain changes in the blood-pressure and in the leucocyte content of the blood also accompany the attacks. With regard to the action of cold in bringing on attacks, it has been noted that paroxysmal hæmoglobinuria was present in 6 per cent. of cases with Raynaud's disease. According to Monro,¹ the hæmoglobinuria in Raynaud's disease is only met with during the existence of local cyanosis. The part played by exposure to cold in determining an attack is an outstanding feature in most instances, and it has been usually possible to produce an attack of hæmoglobinuria by placing the patient's feet in a bath of cold water. It is important to remember, however, that, while cold is the exciting cause of attacks in most instances, there is a minority of cases in which cold is without effect. Thus in certain instances exercise is the determining factor.

In the case of a young man aged 17, observed by Dr. Robert Hutchison (to whom we are indebted for this note), an attack of hæmoglobinuria was determined by a "moderate walk," while "soaking in a cold bath produced no hæmoglobinuria."

With regard to the pathology of paroxysmal hæmoglobinuria, it has been established that the essential feature of the attacks is the occurrence within the circulation of diffusion of hæmoglobin from red blood-corpuscles (hæmolysis), which produces hæmoglobinaemia (Ehrlich²). The excretion by the kidneys of the hæmoglobin thus set free in the plasma leads to hæmoglobinuria. The plasma of patients who suffer from paroxysmal hæmoglobinuria on exposure to cold was shown by Eason³ and by Donath-Landsteiner⁴ to contain an autolysin of the nature of the complex hæmolysins,—*i.e.*, consisting of an immune body which acts along with complement. When the red corpuscles of a patient or another individual are exposed to the hæmoglobinuric's serum at a low temperature the immune body

becomes anchored, and then, at 37° C., the complement acts on the sensitized corpuscles, thus causing hæmolysis. There can be little doubt that the hæmolytic process observed *in vitro* (the Eason-Donath-Landsteiner phenomenon) represents the actual mechanism of attacks in the body of the living subject. The immune body has little or no affinity for the red blood-corpuscles at body temperature, but combines with them when the temperature is lowered. The sensitized corpuscles are then hæmolyzed by the action of complement in the warmer parts of the body.*

In a proportion of cases vasomotor disturbances of Raynaud type must contribute greatly to the development of a temperature sufficiently low to enable the immune body to combine with the red corpuscles. In highly susceptible individuals such vasomotor disturbances may be very readily produced, so that an attack may be initiated without extensive or prolonged chilling. Donath and Landsteiner's⁵ experiments on rabbits have shown that when a limb is chilled a fall of temperature soon occurs in the deep parts which is sufficient to permit of union with the immune body. Of course, it is not necessary to suppose that the quantitative relationships are the same in the body as in the test-tube. In fact, recent experiments of Muir and McNee⁶ on the action of a hæmolytic immune body when injected into the circulation show that much more blood is lysed *in vivo* than *in vitro*. Much more obscure than exposure to cold as a determining cause of hæmoglobinuria is muscular exercise. In this connection the experiments of Fejes⁷ are of interest. He found that no hæmolysin could be demonstrated in the serum of horses which had been injected repeatedly with large quantities of their own washed blood-corpuscles; but if the animals were subjected to severe exercise or were infected with the trypanosomes of dourine, then their serum gave a positive Eason-Donath-Landsteiner phenomenon *in vitro*. The horses did not develop hæmoglobinuria, however. A possible explanation of this type of hæmoglobinuria is afforded by the observation of Van den Berg⁸ and Krokiewicz,⁹ that carbonic acid may cause hæmolysis of hæmoglobinuric blood under conditions which do not affect normal blood, or the phenome-

* For an account of the pathology of paroxysmal hæmoglobinuria see Brown-ing, *Quart. Jour. of Med.*, Oxford, 1913, vol. vi, p. 399.

non may be related to the production of lactic acid, as shown by the increase of lactic acid excreted in the urine under certain circumstances after muscular exercise. The association of hæmoglobinuria with affections of the muscular system is illustrated by the extraordinary case of Meyer-Betz,¹⁰ in which hæmoglobinuria in a boy of thirteen was accompanied by an infiltration of the voluntary muscles which rendered them tense to the touch and which prevented movement. Recovery was associated with contractures in certain muscles. The serum in this case did not cause hæmolysis in the Eason-Donath-Landsteiner experiment. An analogous condition has been observed in horses; but in several instances a thorough examination of the serum failed to show the presence of any hæmolysin similar to that found in human cases of paroxysmal hæmoglobinuria (Meyer-Betz¹¹).

As has been said, however, in the great majority of cases of paroxysmal hæmoglobinuria the attacks are due to cold, and in the serum in most instances an autolysin for the patient's own red blood-corpuses can be demonstrated. Now it is well known, from the classical experiments of Ehrlich and Morgenroth,¹² that a normal animal does not form autolysins. The question, therefore, arises as to what conditions predispose to the formation by the body of lysins for its own tissues. As will be seen, syphilitic infection can be determined as the antecedent condition in practically every case of paroxysmal hæmoglobinuria *e frigore*.

The object of the present work is to deal with the relationship of syphilis to paroxysmal hæmoglobinuria, with special regard to the light thrown on the question by the biological syphilis serum reaction of Wassermann, Neisser and Bruck. The effect of anti-syphilitic treatment will also be considered.

The association of syphilitic infection with paroxysmal hæmoglobinuria in a proportion of cases has long been noted. Thus Ehrlich's² patient, observed in 1881, a woman, aged 27, was infected with syphilis and was cured of hæmoglobinuria by antisyphilitic treatment, as also were cases investigated by Murri.¹³ Till recently the only conclusive evidence of syphilitic infection in any individual was the presence or previous occurrence of typical syphilitic lesions, and these were wanting in many cases of paroxysmal hæmoglobinuria. Where also there is a very long interval between

the primary infection and the first occurrence of hæmoglobinuria (30 years in a case described by Királyfi¹⁴) the evidence of a close association with syphilis is, on purely clinical grounds, obviously not strong. Stempel¹⁵ found a syphilitic history in only 29 per cent. of 77 cases; but there was evidence of syphilis in 60 per cent. of the 39 cases collected from the records of Guy's Hospital by Macalister.¹⁶ Accordingly, it was impossible to draw any definite conclusion, and the attitude of English observers seems to be fairly expressed by Garrod¹⁷ when he says "in some cases this malady would appear to have a syphilitic origin . . . but not unfrequently no such antecedent cause can be traced." Herringham¹⁸ states that "there are certain factors which predispose to hæmoglobinuria; one is undoubtedly syphilis." The discovery, however, of the fact that syphilitic serum along with certain tissue lipoids causes absorption of hæmolytic complement *in vitro* (the syphilis reaction of Wassermann, Neisser and Bruck) has afforded a new method for the investigation of the etiology of many previously obscure diseases. The value of the test depends on its specificity as well as on its delicacy. With regard to the specificity of the reaction it has been found that the blood-serum in no other condition, with the exception of frambæsia, tuberculous leprosy, and possibly trypanosomiasis and malaria, gives a positive reaction. The delicacy of the test appears from the fact that a positive reaction is obtained with the sera of 95 per cent. of secondary cases, of 75 per cent. in the tertiary stage, and with 50 per cent. of syphilitics in the latent periods. Thus it is evident that the occurrence of a positive reaction is of great importance in the diagnosis of a condition as due to syphilis. The blood in a considerable number of cases of paroxysmal hæmoglobinuria has been examined for the Wassermann reaction, and those in the literature will be referred to before proceeding to discuss our own cases in greater detail.

*Betti.*¹⁹—Man, aged 41, had syphilis 22 years before—Wassermann reaction positive.

*Bürger.*²⁰—CASE I.—Man, aged 42. First attack of hæmoglobinuria eight years before. He suffered from gonorrhœa as a young man, but there never was a chancre; there was a severe attack of rheumatism 26 years before. Wassermann reaction markedly positive. (Syphilis can practically be excluded, according to Bürger!)

CASE II.—Man, aged 31. On April 9, 1910, he fell from a wagon and struck his left side and shoulder, but did not become unconscious, and in a few minutes could rise and walk home. He could not work next day on account of pain in his back and side. After antirheumatic treatment for five days he was fit for work, but he suffered occasionally from slight pain in his back. On April 11, 1910, there was a sudden onset of giddiness. The patient felt ill, and there was vomiting; he had great inclination to pass urine, and voided bloody urine. The attack soon passed off. The patient was married; his wife was healthy and had had no abortions; there were two healthy children. There was no history of venereal disease and no clinical evidence of syphilis. The patient's serum reacted markedly positive in the Wassermann test. No albumin was present in the cerebrospinal fluid by the Nonne-Apelt test. The Wassermann reaction was negative with the cerebrospinal fluid. A trace of albumin and scanty granular casts were present in the urine after an attack. Repeated hæmoptysis without clinical signs in the lungs occurred. A footbath at 6° C. for 12 minutes caused a fall of hæmoglobin (85 per cent. to 62.5 per cent. in two hours and forty minutes) and the appearance of urobilinogen in the urine, but no hæmoglobin.

CASE III.—Of 182 cases with a positive Wassermann reaction, one gave a positive Donath-Landsteiner phenomenon, but only with red blood-corpuscles of other persons. This was a girl 20 years old; she said spontaneously that a younger brother suffered from attacks of dark urine. Immersion of feet and legs for 20 minutes in a cold bath caused no hæmoglobin or urobilinogen in urine.

*Coca and L'Esperance*²¹ obtained a positive Wassermann reaction in a case of paroxysmal hæmoglobinuria.

*Cooke*²²—The case was that of a negro, aged 38; he reacted positively to the Wassermann test, but presented no other evidence of syphilis.

*Fejes and Kentsler*²³—Man, aged 43. Hæmoglobinuria began one year before. There was a history of syphilis acquired in youth. Wassermann reaction negative.

*Glaessner and Pick*²⁴—Man, aged 48. First attack of hæmoglobinuria seven years before. Wassermann reaction weakly positive. Married 18 years. There were two healthy children. His wife had had no abortions. The patient's pupils were narrow and unequal; they reacted sluggishly to light.

*Graf*²⁵—Boy, aged 10. Hæmoglobinuria appeared first at the age of 5; the attacks increased in frequency, and finally occurred even in summer weather or while the patient lay at rest in his bed. The Wassermann reaction was markedly positive. Hutchinson's teeth were present. There was no history of syphilis in the family. The patient's father and mother and sisters were well. With the father's serum the Wassermann reaction was weakly positive, with that of the mother negative.

*Graf and Müller*²⁶—A man, aged 66. The first attack of hæmoglobinuria occurred five years previously. There was no evidence of syphilis on physical

examination or in the history of patient or in his family by his first wife. Second wife childless. Wassermann reaction positive with the patient's serum.

*Kumagai and Inoue*²⁷ examined 20 cases. Seven with acquired syphilis, aged from 27 to 53, all reacted positively in the Wassermann test. Of 10 in which the syphilis was congenital, aged 6 to 42, all reacted positively except one, aged 27. In three others, males, aged 14, 24, and 49, the Wassermann reaction was markedly positive, but no other evidence of syphilis could be obtained.

Matsuo.²⁸—Out of 11 cases of paroxysmal hæmoglobinuria, 10 reacted positively in the Wassermann test, and in 8 of them there was a history of syphilis, 6 being congenital. The negative case had a history of syphilitic infection 23 years previously. The cases recorded by this observer show strikingly the hereditary predisposition to paroxysmal hæmoglobinuria noted by Herringham¹⁸ and others. Thus in one family, of which the father was syphilitic, two out of three children suffered from hæmoglobinuria, and a child of each of two older sisters of the father had the disease. In another case of a child, the father was syphilitic and suffered from hæmoglobinuria.

Moss.²⁹—CASE I.—A negress, aged 8; hæmoglobinuria began at the age of 3. Patient was small but well nourished; teeth normal; exophthalmos present; thyroid not enlarged; liver enlarged; spleen slightly enlarged; cervical, axillary, inguinal and epitrochlear glands markedly enlarged. Wassermann reaction positive. There were three older children; the first died of diphtheria, aged 9; the second died when a few days old, of umbilical hemorrhage; the third suffered from umbilical hemorrhage when 12 hours old, two other hemorrhages occurred, and the child died from this cause when 1 month old. The fifth child was alive and well; the sixth child was still-born. Father alive and well—Wassermann reaction negative. Mother alive, suffered from asthma and from excessive bleeding at menstrual periods and in childbirth—Wassermann reaction positive.

CASE II.—Negro, aged 7; hæmoglobinuria began two and one-half years before. Teeth normal; no evidence of syphilis on physical examination. Wassermann reaction positive. Father alive and well, Wassermann reaction negative. Mother alive and well, has had four miscarriages. A brother of the patient died at the age of 2 months (cause unknown).

CASE III.—Man, aged 32. First attack of hæmoglobinuria eight years before. Wassermann reaction positive.

Moro, Noda and Benjamin.³⁰—A boy, aged 4. The first attack of hæmoglobinuria occurred at the age of 2. Patient was the youngest of a family of three; the other two children were alive and well. There was no evidence of syphilis in patient's appearance. Wassermann reaction positive.

Pringsheim.³¹—A man, aged 34. The first attack of hæmoglobinuria occurred when 32 years old; there had been an "ulcer on the neck" shortly before, which lasted about a week and then healed. He was 11 years married. His wife had never aborted. There were three children, one of whom, while young, died of convulsions. Patient's inguinal glands are enlarged; the right epi-

trochlear glands are of the size of lentils, firm and not tender. Wassermann reaction positive.

*Scheidemantel's*³² case, a girl, aged 23 years, gave a marked positive Wassermann reaction.

*Takahara.*³³—Five cases in Japanese children; Wassermann reaction positive in four.

*Tedesko's*³⁴ case was somewhat anomalous. Paroxysmal hæmoglobinuria occurred shortly after an attack of nephritis (albuminuria and general œdema). The patient, a man aged 31, reacted negatively in the Wassermann test. His blood gave a positive Donath-Landsteiner phenomenon. There was no history of syphilis.

We have had the opportunity of observing six cases of paroxysmal hæmoglobinuria. In addition to examining the patients themselves for the Wassermann reaction, etc., we have also, whenever possible, tested the sera of the parents and of other members of the families. Such investigation of families is of the highest value in determining the association of syphilis with any particular condition, since, as has already been mentioned, the occurrence of a positive Wassermann reaction, even in the absence of recognizable syphilitic manifestations, affords, under the conditions mentioned above, conclusive evidence of the existence of syphilitic infection in the positively reacting individual. The converse, however, does not invariably hold. Thus the subject of syphilitic infection may react negatively. The occurrence of a negative reaction in cases of syphilis has several explanations. In the first place, the presence of the reacting bodies in the serum is an indication of a biological alteration in the tissues. Now, no biological phenomenon occurs invariably in all individuals. Accordingly, a very small number of cases of syphilis react negatively, even in the secondary stage, at a time when active spirochætes are present in great numbers and are diffused throughout all the tissues. Again, syphilis, like other protozoal diseases, is characterized by periods of latency, during which the tissues of the host maintain an equilibrium with the parasite; at such a stage no clinical phenomena of the active disease are present, and the Wassermann reaction is negative in a large number (about 50 per cent.). A third possible reason for a negative result is that the pathogenic action of the spirochætes may be limited to a small extent of tissue, so that the reacting substances which reach the serum are not sufficient in amount to cause a positive reaction. This

last explanation applies to the cases with limited tertiary lesions which react negatively and also to the cases in which, after treatment, localized syphilitic recurrences in nerves are accompanied by a negative Wassermann reaction at a time when the disturbance of nervous function (*e.g.*, facial paralysis) supervenes. In the latter cases, however, the reaction becomes positive later on when the spirochaetes have multiplied and extended their field of action. Thus the group of negatively reacting persons comprises a considerable number of syphilitics. Accordingly, if a child has been affected with a condition which is possibly of syphilitic origin, but its serum reacts negatively, the proof of the existence of syphilis may be rendered practically conclusive by finding that other children of the same parents give a positive reaction. A positive reaction in one or both parents is also significant. The practical application of this point will be clearly apparent in connection with Case III.*

The application of the Wassermann reaction *in extenso* to the investigation of families affords, in addition, a valuable means for controlling the family history, which, although discredited by some observers, undoubtedly affords important evidence.

CASE I (March, 1912—Wards of Dr. Cowan, Royal Infirmary, Glasgow).—R. P., male, aged 17. Wassermann reaction positive. The central incisors are short, broad, and wide apart, with the suggestion of a notch. The patient is mentally somewhat dull. Height, 5 feet 5 inches; weight, 8 stone 4 pounds. The first attack of paroxysmal hæmoglobinuria occurred at the age of 12, two months after pneumonia. The attacks were induced by cold, especially along with excitement,—*e.g.*, after outdoor games at school. The attacks occurred, on an average, at intervals of five weeks, but were more frequent in very cold weather. Shivering occurred about eight hours before the hæmoglobinuria; other prodromal symptoms were frontal headache, a feeling of numbness all over the body, and blueness of the lips. On admission to hospital at that time it was noted that the patient's feet were blue, but there was no œdema, and no casts were present in the urine. Profuse sweating occurred two to three days after the attacks. The paroxysms of hæmoglobinuria continued to occur for two years. At the age of 14 he began work as a miner: the last attack occurred two and one-half years ago and lasted for one day.

*The test for the Wassermann syphilis reaction was in every instance carried out by the lecithin-cholesterin method of Browning, Cruickshank and Mackenzie (Browning and Mackenzie: "Recent Methods in the Diagnosis and Treatment of Syphilis," London, 1911), in which the amount of complement absorbed by the mixture of patient's serum and "antigen" and by each reagent separately is accurately measured.

Family History.—Patient's father and mother are alive and well. Both react negatively to the Wassermann test. There have been no miscarriages. There is only one other child, a boy, aged 14. His heart is enlarged; with his blood-serum the Wassermann reaction is negative.

It is interesting to note that the Donath-Landsteiner reaction is still given at the age of 17, although no hæmoglobinuric attacks have occurred during this prolonged period.

CASE II (December, 1911—Wards of Professor Hunter, Royal Infirmary, Glasgow).—E. S., aged 5½ years. A well-nourished girl, with no evidence of disease in any organ and with no appearance at all suggestive of congenital syphilis. The child never had any eruptions, and enjoyed good health except for an attack of pneumonia when 2 years old. The first attack of hæmoglobinuria occurred at the age of 3, after being out of doors in cold weather. The attacks at first occurred several times a week. After exposure to cold, shivering occurred, and then the child fell asleep; on waking, the first specimen of urine which was passed contained hæmoglobin; later the hæmoglobinuria persisted for about 12 hours. Attacks occurred throughout the winter of 1909–1910. The child was admitted to hospital for the first time in the spring of 1911. In April, 1911, an attack was brought on by a cold foot-bath; the hæmoglobinuria which occurred lasted for 48 hours. Attacks ceased during the spring and summer, but in October they occurred again, the first appearance of hæmoglobinuria occurring 10 minutes after the shivering. In November, 1911, attacks occurred twice daily, even although the child was kept entirely in bed. The Wassermann reaction with the blood-serum was positive on several occasions in April, 1911; in December, 1911, the reaction was negative or only weakly positive on repeated tests. A positive Eason-Donath-Landsteiner phenomenon was repeatedly obtained with the patient's serum.

From November, 1911, to January 30, 1912, she was again resident in the hospital. Regular outdoor exercise in cold weather during this period produced no hæmoglobinuria; but on the day of dismissal an attack occurred which lasted three days. *Family History.*—The patient's mother is aged 35; she has been twice married. Of the first marriage the three eldest children are alive and well; the fourth died at 2½ years of pneumonia; the fifth pregnancy ended in a stillbirth at the seventh month. During this pregnancy the husband suffered from venereal infection and his hair fell out; the wife was troubled with sore throat, continuous headache, and a persistent, blood-stained, purulent vaginal discharge. She is not aware of any rash having been present. The sixth pregnancy resulted in a miscarriage. The seventh child was born at full time and died, aged 3 months, with an eruption on the nates. Of the second marriage the first child was born at full time; a bullous eruption appeared on its feet at the age of 2 weeks; the child never thrived and died at 3 months. The second child is the patient. The third child, aged 3½ years, was born at full time, and has always been healthy, with no stigmata suggesting syphilis; the Wassermann reaction is positive. The fourth child is 15 months old and in poor health (blood reaction not tested). The mother's blood reacted positively to the Wassermann test in March, 1911, but negatively on repeated examination in

December, 1911. The second husband, father of the patient, presented no signs of the disease and had never shown any evidence of syphilis. In December, 1911, his blood gave a negative Wassermann reaction.

CASE III (April, 1912).—L. J., a girl, aged $6\frac{1}{2}$ years. The first attack of hæmoglobinuria occurred seven months before. On physical examination there is no evidence of syphilis. The Wassermann reaction is negative with her serum. A Donath-Landsteiner reaction was not obtained even when human complement from another person was added. *Family History*.—Father not examined. Mother is aged 39 and has had no manifestation of syphilis—Wassermann reaction negative. The first three pregnancies resulted in abortions; the fourth pregnancy resulted in a child which died aged 14 months (from teething!); the fifth child, a girl, aged 16, is well, but appears mentally dull and has teeth of Hutchinson type; her serum reacts positively in the Wassermann test. The sixth child, aged 13, was suffering from rheumatic fever and chorea at the time of examination; Wassermann reaction negative. The seventh child died when one year old from convulsions. The eighth is the patient. The ninth died, aged 6 months, from convulsions. The tenth is a baby, alive and well (blood not tested).

CASE IV (May, 1912—Wards of Dr. Monro, Royal Infirmary, Glasgow).—W. W., a boy, aged 8 years, healthy and bright, with no evidence of syphilis. The Wassermann reaction is positive. Donath-Landsteiner reaction positive. The first attack of hæmoglobinuria occurred in March, 1912. Attacks were associated with shivering, headache, vomiting, and cyanosis of lips and ears. *Family History*.—Father had venereal disease at 18; his hair fell out in patches, and he suffered from severe headache; he was treated for a month in the Royal Infirmary. Wassermann reaction positive at the present date. When 21 years old he married patient's mother. The mother had a labial sore after marriage. She has been married for ten years. There is the suspicion of her having had a miscarriage before she had any children. The Wassermann reaction is positive with the mother's serum. The first child is the patient; the second child is a girl, aged 6, who looks healthy and bright, with no evidence of syphilis—the Wassermann reaction is positive. The third child is a boy, aged 4, healthy—the Wassermann reaction is negative. The fourth child is $2\frac{1}{2}$ (not examined).

CASE V (March, 1911—Wards of Professor Hunter, Royal Infirmary).—A. K., man, aged 27. The first attack of hæmoglobinuria occurred three years ago. Attacks occur only in very cold weather, on exposure to damp in pursuit of his occupation as a tile-layer, which the patient has followed since the age of 14. Outdoor work as a laborer in cold weather does not cause attacks, provided that the patient keeps himself warm by continuous exercise. The Wassermann reaction is positive. The patient suffered from a penile sore at the age of 17. He was treated for a fortnight only. He was married at 20. Of four children, three are alive and well, aged $6\frac{1}{2}$, $5\frac{1}{2}$, and 2 (not examined). The fourth died of pneumonia. Patient's wife has had no miscarriages—Wassermann reaction negative.

CASE VI (December, 1912—Wards of Dr. Ness, Western Infirmary, Glasgow).—M. C., a girl, 9 years old, healthy looking, well nourished, and without any definite stigmata of hereditary syphilis, although the upper central incisors

are wide apart, short, and pegged. The first attack of hæmoglobinuria occurred at the age of $2\frac{1}{2}$ years, and there was no other for six months. Thereafter attacks became more frequent. The child had measles when 6 months old. During her second year her state of nutrition was apparently poor (she was said to suffer from "decline"), and she was affected with snuffles. The Wassermann reaction is positive. Donath-Landsteiner phenomenon positive. *Family History*.—The father had syphilis. The first three children were born dead. The fourth child (aged 8), the fifth (aged 6), and the seventh (aged 5 months) died almost simultaneously, all probably from cerebrospinal meningitis. The patient is the sixth child.

The general results in our six cases are as follows:

I. A positive Wassermann reaction has been obtained with the serum of all the patients but one (Case III).

II. Four of the five children affected with hæmoglobinuria present no appearance of syphilitic stigmata. Two at least (Cases II and IV) are very bright and healthy looking.

III. A positive Wassermann reaction has been obtained with the blood-serum of a relative (parent, brother, or sister) in the case of three out of four families to which the hæmoglobinuric children belong. Among those reacting positively is an elder sister of the negatively reacting hæmoglobinuric patient (Case III).

IV. The adult patient has a history of acquired syphilis, in addition to a positive Wassermann reaction.

V. There is clinical evidence of syphilis in the parents of all the five children except Case I. The mothers of Cases II, III, and VI had repeated abortions. In Case IV there is a fairly definite history of a miscarriage and the mother had a labial sore shortly after marriage; while the father admits venereal infection before marriage. The serum of both parents reacts positively in the Wassermann test. Including all the cases recorded in the literature, the Wassermann reaction has been tested in 59 patients with paroxysmal hæmoglobinuria, and a positive result has been obtained in 53, or 90 per cent.

The occurrence of a positive Wassermann reaction with the serum of the majority of cases of paroxysmal hæmoglobinuria, along with the collateral evidence afforded by the presence of a positive Wassermann reaction with the sera of other members of families—even where the patient reacts negatively, as in Case III, the history pointing to syphilis in the parents of hæmoglobinuric children, and the stigmata of congenital syphilis in brothers and sisters, although absent in the patients themselves, constitute a very strong basis for

the opinion that *syphilitic infection is practically invariably present in cases of paroxysmal hæmoglobinuria e frigore*. The occurrence of a positive Wassermann reaction in these patients is almost as constant a feature as in cases of general paralysis (v. Browning and Mackenzie). Certain observers have considered that the evidence of syphilis is not conclusive; thus Bürger²⁰ holds the view that in cases of paroxysmal hæmoglobinuria the presence of a positive Wassermann reaction without a history or other evidence of syphilis indicates an existing blood disease which is not syphilis. Noguchi (quoted by Cooke²²) found that "complement binding rarely took place when he used as antigen his pure culture of *Treponema pallidum*, although the Wassermann reaction done simultaneously was positive." Even on purely clinical grounds, however, the histories of "occult" syphilis such as have been recorded by Fleiner and Kaufmann-Wolff,³⁵ as well as the cases recorded here, indicate that very great care must be exercised before syphilitic infection can be excluded in any instance. Accordingly, there appears to be no very good ground for excluding syphilis, as Bürger has done in his case which reacted positively in the Wassermann test. The occurrence of a positive Wassermann reaction with the patient's serum has naturally suggested the adoption of antisyphilitic treatment. Choroschilow³⁶ observed no beneficial effect with potassium iodide. Moss²⁹ treated one case (No. I) with 0.3 gramme salvarsan intravenously, which appeared to cause improvement. Matsuo²⁸ found that salvarsan did not produce amelioration of the condition except in one out of eight cases. He administered an intravenous dose of 0.3 gramme salvarsan usually, and then gave a similar dose about a week later, or gave an equal amount subcutaneously at the same time as the intravenous injection. In Betti's case two doses of salvarsan caused the attacks to cease. Cases II, IV, and V of our series were treated with salvarsan, but the observations have not been sufficiently extensive to permit of conclusions. The general experience, however, is that paroxysmal hæmoglobinuria resembles interstitial keratitis and the so-called parasymphilitic affections in its resistance to specific treatment.

We have much pleasure in expressing our thanks to Drs. Cowan, Hunter, Monro, and Ness for their kindness in placing the cases at our disposal.

BIBLIOGRAPHY

- ¹ Monro: "Raynaud's Disease," Glasgow, 1899.
- ² Ehrlich: *Gesammelte Mittheilungen*, Berlin, 1891.
- ³ Eason: *Edinburgh Med. Journ.*, 1906, vol. xix, p. 43; *Journ. of Path. and Bact.*, 1906, vol. xi, p. 167 (which contains full references to earlier literature).
- ⁴ Donath and Landsteiner: *Münch. med. Woch.*, 1904, p. 1590.
- ⁵ Donath and Landsteiner: *Centralbl. f. Bakt.*, I, Orig. 1908, Bd. xlv, p. 205.
- ⁶ Muir and McNee: *Journ. of Path. and Bact.*, 1912, vol. xvi, p. 410.
- ⁷ Fejes: *Zeitschr. f. klin. Med.*, 1911, Bd. lxxii, p. 377.
- ⁸ Van den Bergh, *Berlin. klin. Woch.*, 1909, p. 1251.
- ⁹ Krokiewicz: *Wien. klin. Woch.*, 1911, p. 487.
- ¹⁰ Meyer-Betz: *Deutsch. Archiv. f. klin. Med.*, 1910, Bd. ci, p. 85.
- ¹¹ Meyer-Betz: *Deutsch. Archiv. f. klin. Med.*, 1911, Bd. cihi, p. 150.
- ¹² Ehrlich and Morgenroth, in Ehrlich's "Collected Studies on Immunity," New York, 1910.
- ¹³ Murri: See Macalister (No. 16).
- ¹⁴ Királyfi: *Fol. Serol.*, 1910, vol. v, p. 277.
- ¹⁵ Stempel: *Centralbl. f. d. Grenzgeb. d. Med. u. Chir.*, 1902, Bd. v, p. 184.
- ¹⁶ Macalister: *Quart Journ. of Med.*, 1909, vol. ii, p. 368 (which contains full references to earlier literature).
- ¹⁷ Garrod, in Osler and McCrae's "System of Medicine," 1909, vol. vi.
- ¹⁸ Herringham: "Diseases of the Kidneys," Oxford, 1912.
- ¹⁹ Betti: *Morgagni I*, 1912, vol. liv, p. 201.
- ²⁰ Bürger: *Zeitschr. f. exper. Path. u. Ther.*, 1912, Bd. x, p. 191.
- ²¹ Coca and L'Esperance: *Zeitschr. f. Immunitätsforsch.*, 1912, Bd. xiv, p. 139.
- ²² Cooke: *Amer. Journ. of Med. Science*, 1912, vol. cxliv, p. 203.
- ²³ Fejes and Kentzler: *Zeitschr. f. klin. Med.*, 1910, Bd. lxxi, p. 194.
- ²⁴ Glaessner and Pick: *Zeitschr. f. exper. Path. u. Therapic*, 1911, Bd. ix, p. 581.
- ²⁵ Grafe: *Deutsch. med. Woch.*, 1911, No. 44.
- ²⁶ Grafe and Müller: *Arch. f. exper. Path. u. Phar.*, 1908, Bd. lix, p. 97.
- ²⁷ Kumagai and Inoue: *Deutsch. med. Woch.*, 1912, p. 361.
- ²⁸ Matsuo: *Dtsch. Arch. f. klin. Med.*, 1912, Bd. cvii, p. 335.
- ²⁹ Moss: *Bulletin of Johns Hopkins Hosp.*, 1911, vol. xxii, p. 238.
- ³⁰ Moro, Noda and Benjamin: *Münch. med. Woch.*, 1909, p. 545.
- ³¹ Pringsheim: *Münch. med. Woch.*, 1912, p. 1757.
- ³² Scheidemantel: *Münch. Med. Woch.*, 1909, p. 2500.
- ³³ Takihara, cited in *Zeitschr. f. Immunitätsforsch. Ref.*, 1910, p. 1008.
- ³⁴ Tedesco: *Wien. klin. Woch.*, 1912, p. 1416.
- ³⁵ Kaufmann-Wolff: *Zeitschr. f. klin. Med.*, 1912, lxxv, p. 187.
- ³⁶ Choroschilow: *Zeitschr. f. klin. Med.*, Bd. lxiv, H. 5, 6.

FACTORS IN THE CLINICAL PHYSIOLOGY OF THE HEART

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THE PRINCIPLES OF CARDIAC NUTRITION

Fundamental Importance of Cardiac Nutrition.—In these pages it will be assumed that the work power of the heart depends directly upon the nutrition of the organ. In other words, the normal heart-beat is the expression of metabolic processes having a certain quality and intensity, and compensation for defects due to disease can only be secured by an approach to such metabolism. It is well to clearly apprehend that the automaticity and mechanical efficiency of the heart are enhanced by every circumstance which favors cardiac nutrition and degraded by every influence that retards it. Successful resuscitation of stilled hearts many hours after systemic death proves that the contractile molecule may still maintain its chemical integrity when all signs of somatic life have ceased, and may again be stirred up to functional activity by a supply of stimulating and nutritive material.

From a practical therapeutic, no less than from a scientific, standpoint it is of the utmost importance that we be able to define exactly what are the various agents which normally affect the nutrition of the heart. In the present state of knowledge this can be done but very incompletely. Still, there is definite value in even a tentative classification of forces capable of modifying cardiac nutrition. We can recognize at least three such sources of influence in (1) the extracardiac nerves; (2) the chemical constitution of the blood and lymph; (3) the contractile movements of the heart itself. The relations of the extracardiac blood-pressures are too apparent to be dwelt upon. As the present essay is aimed merely to apply physiological facts to clinical conditions, the first group of influences may be dismissed with a word, after premising that

therein, probably, will be expended much of the energy of the future clinician. It is an attractive contention of Gaskell's¹ that the inhibitory fibres travelling in the vagus operate on the cardiac muscle in such a way as to accelerate assimilation, anabolism, or constructive metabolism, leading to the storage of potential energy and functional rest, while the accelerator and augmentor branches of the sympathetic system carry impulses which cause disassimilation, catabolism, the liberation of energy, and functional activity.

We are not yet prepared to link these physiological conceptions to the verities of clinical experience which demonstrate conclusively the fundamental connection between the *psychic* condition and cardiac nutrition,—whether manifested in the sudden syncope or palpitation caused by mental emotion or the more gradual development of circulatory power resulting from a favorable social or climatic change.

It is not improbable that all our notions of the way in which the extracardiac nerves operate upon the heart must be revised in the light of the recent discovery by Howell that vagus inhibition is brought about directly through the action of potassium ions on the cardiac automaton, the alkaline ions being liberated under influence of the vagus nerve impulses.²

The second group of conditions affecting cardiac nutrition, the chemical constitution of the blood and lymph, is recognized by physiologist and clinician alike as of supreme importance. Unfortunately, here, too, the physiological *data* have thus far chiefly academic interest, though already clinical practice owes some of its most valuable devices to laboratory determinations in this field.

Physiologists are still in debate as to the origin of the automaticity of the heart,—whether the contractions are started by periodic discharges from intrinsic ganglion-cells, or whether the muscle-fibres themselves are endowed with the property of automatic contractility. These two views of the origin of the heart-beat are known respectively as the neurogenic and myogenic theories of cardiac ac-

¹ W. H. Gaskell, "On the Structure, Distribution, and Function of the Nerves Which Innervate the Visceral and Vascular Systems," *Journ. of Physiology*, 1886, vii, 1.

² W. H. Howell and W. W. Duke, "The Effect of Vagus Inhibition on the Output of Potassium from the Heart," *Amer. Journ. Physiology*, 1908, xxi, 51.

tivity.³ Recent researches indicate that the physical substratum of coördinated automaticity is to be found in certain "nodal" points in the cardiac tissue. The nodes seem to resemble embryonic tissue and partake of the nature of both nerve and muscle. The normal heart-beat is probably initiated in such a node found near the origin of the superior vena cava in the wall of the right auricle.⁴

When the heart of a mammal is exposed and gradually allowed to fail the left ventricle is said to stop first, then the right ventricle, and last the right auricle. Rhythmic twitching of the muscles at the roots of the great veins entering the right auricle may be seen long after the organ has become motionless. The same results follow whether the heart stops in paralytic distention, as in ordinary death, or is emptied of blood by artificial means. The heart which has thus come to rest is not dead, but, if properly supplied with certain chemicals in solution, it enters again upon a course of automatic contractions. Such a result is obtained by artificially re-establishing the coronary circulation with an appropriate fluid medium. Experimenters have been astonished at the trifling amount of material which thus suffices to maintain the nutrition of the heart. Instances are reported in which empty cat-hearts carried on their contractions when the coronary circulation was supplied with a current of blood at the rate of but two to three c.c. per minute. It is impossible to say at present whether the effective circulating medium actually supplies material for constructive metabolism in the cardiac molecule or only brings to bear a stimulus especially adapted to excite the irritability of the contractile substance and thus set free its energies. We feel sure that proteid material is necessary to maintain the nutrition of all living cells, while, at the same time, their functional display of energy may be due solely to the oxidation of non-proteid constituents of their substance, such as sugars. But the heart-beat can be maintained for prolonged periods under the influence of a circulating medium composed of a dilute solution of mineral salts. The researches of a clinician, Dr. Sidney Ringer,⁵

³ Cf. Howell's "Text-book of Physiology, on the Cause and Sequence of the Heart-beat"; also, S. J. Meltzer, "The Neurogenic and Myogenic Theories," etc., *New York Med. Record*, 1909, lxxv, 873.

⁴ Cf. Critique by Jos. Erlanger, *Archives Int. Med.*, 1913, xi, 334.

⁵ Sidney Ringer, *Journ. of Physiology*, vol. iii et seq.

deserve recognition as the chief basis for our present knowledge of the physiological importance of the inorganic salts. Ringer found that three elements—potassium, sodium, and calcium—were of fundamental importance in maintaining the contractility of the heart. The excised heart of a frog or terrapin will beat for many hours if supplied with a current of “Ringer’s solution” or some modification of it. According to Howell,⁶ the following saline composition in distilled water is most suitable to maintain the heart-beat of the frog or terrapin:

NaCl	0.7	per cent.
KCl	0.03	per cent.
CaCl ₂	0.025	per cent.

For maintaining the activity of the isolated mammalian heart a solution recommended by Locke secures best results. It is composed of NaCl 0.9 per cent., CaCl₂ 0.024 per cent., KCl 0.42 per cent., NaHCO₃ 0.01 to 0.03 per cent., dextrose 0.1 per cent. “The solution is fed to the heart under an atmosphere of oxygen, and with this solution Locke and others have kept the mammalian heart beating for many hours.”⁷

Physiologists are agreed that the three mineral bases, or the “ions” sodium, potassium, and calcium, are all necessary to the maintenance of the heart-beat, and that, moreover, each ion has a specific physiological action. There is still some dispute, however, as to the proper reference of some of the observed effects. According to Howell, sodium chloride exists in the blood plasma to the extent of 0.5 to 0.6 per cent., and the normal osmotic pressure of the blood is mainly dependent upon it. Irritability and contractility of the heart muscle disappear when sodium is absent from the circulating fluid; on the other hand, when supplied only with a solution of chloride of sodium in physiological concentration, the heart muscle relaxes and soon comes to rest. The calcium ions are present in the blood and lymph in very small proportions, but they are, nevertheless, indispensable to cardiac activity. When they are absent from the circulating fluid, the heart soon comes to rest. When present in excess, the heart is thrown into a condition of tonic contraction. The

⁶ W. H. Howell, “Text-book of Physiology,” 2d Ed., p. 520.

⁷ Howell, *op. cit.*, p. 914 *et seq.*

potassium ions have a physiological effect apparently opposite to that of the calcium. When in excess they cause slowing of the heart-beat and, finally, a complete relaxation of the cardiac muscle. They seem in some way to regulate the rate of the heart-beat.

Kuliabko⁸ has studied the stages of heart-failure in the mammal and has demonstrated, as have others, the extraordinary recuperative powers of the cardiac muscle. This experimenter removed the hearts from rabbits and preserved them in an ice-chest for more than forty hours. The organs were then irrigated through the coronary vessels with a warm Locke's fluid; by this procedure pulsation was restored to the organs and continued for several hours. In a similar manner he was able to restore pulsation to the hearts of rabbits dead of disease as late as three or four days after death. Extending his researches to the human heart, Kuliabko succeeded in resuscitating this organ as late as twenty to thirty hours after systemic death.

To the list of chemical agents which are indispensable in securing and maintaining contractions in the isolated heart oxygen must usually be added. Thus Locke, in his original demonstration of the successful resuscitation of the mammalian heart, supplied the organ with a saline fluid under an oxygen pressure of two atmospheres.

The writer was recently much impressed with the influence of oxygen inhalations in restoring the vital movements in the case of a man dying with fibroid phthisis. Again and again during the course of a night the powers would wane, the respiration would become more and more shallow and the heart sounds feebler to near extinction, and the patient sink into a repose as of deep narcosis. Just as often would the administration of oxygen from a tank be followed by a recovery of the heart-beat, a deepening of respiration, an improvement in the color of the skin and a general nervous awakening. Under the influence of this and other stimulation the patient was restored to consciousness and relative activity, and he lived for a week thereafter.

Kuliabko's observations on the sequence of events in experimental heart-failure possess considerable interest for the clinician. He found that when the artificial circulation which maintains the beat

⁸ Kuliabko, "Studien ü. die Wiedererholung des Herzens," *Arch. f. d. ges. Physiologie*, xc, s. 461; "Wiederbelebung des Herzens," *Zentralbl. f. Physiologie*, xvi, 330; Ref. in Hermann's *Jahresbericht. ü. Physiologie*, 1902.

of the isolated mammalian heart is interrupted there ensues a period in which every second heart-beat is weaker, having a strength of one-fourth to one-fifth of the other. This weakness at first involves the left ventricle only; later, all the chambers of the heart pulsate more feebly and at a slower rate. Then there are occasional strong systoles interposed among the weaker; then the whole heart comes to rest, the ventricles failing first. When the circulation is restored, the heart begins to beat again, the auricles being resuscitated first and the ventricles last.

But it is the third group of conditions, the mechanical movements of the heart, whose influence upon the nutrition of the organ must awake peculiar interest in the clinician. The function of the heart is, broadly speaking, to expel a certain amount of blood with each contraction, estimated in man to vary between 50 and 100 c.c. (1.7 to 3.4 fluidounces) for each ventricle. Notwithstanding its extraordinary complexity of structure and variety of movement it may be suspected as hardly admitting of doubt that no single attribute of the heart fails to aid in fulfilling the main purpose of the organ as a pump. It is generally admitted that the contracted ventricle at the end of systole retains still a small amount of "residual blood." It is also believed that the auricles, at a similar phase of their cycle, hold a very considerable but variable quantity of fluid. The change in volume between systole and diastole in any chamber of the heart must represent, with a given rate of beat, precisely the pumping efficiency of the organ; for it indicates the amount of blood entering and leaving the cavity during each cycle. No single observation, therefore, could more exactly portray the pumping efficiency of the heart than a comparison of its volumes during systole and diastole. Unfortunately, we have as yet no practical clinical method of ascertaining this relation. The clinician, however, must continually bear in mind the vital importance of *amplitude* of movement in the contracting heart, and also the kindred fact that the ventricles at the end of systole should contain but a very small amount of residual blood.

The nutrition of the heart is largely dependent upon the intrinsic movements of the organ, and there is good reason for assuming that the intensity of cardiac metabolism is fairly proportional to the amplitude of cardiac movement or the difference in volume between

systole and diastole. Thus Porter⁹ has shown that the volume of blood passing through the coronary vessels of the dog's heart is increased either by acceleration of the beat or augmentation in its force. That is to say, the ventricle in its contraction squeezes the blood out of the coronary vessels, which, thus relaxed at the beginning of diastole, offer very little resistance to refilling. It has been proved¹⁰ that when the ventricles contract the compression of their fibres causes a sudden spurt of blood from the coronary veins, and there is a sharp rise of blood-pressure in the arteries; as the systole persists the coronary capillaries remain empty and the velocity of outflow suddenly diminishes, or the current is even reversed; at the same time there is a second marked rise of blood-pressure in the coronary arteries due to the shutting of the capillaries. When the ventricles relax, the coronary veins and capillaries are opened, the pressure in the coronary arteries suddenly falls, and the velocity of the flow from the coronary veins correspondingly increases.

Observations of Hyde¹¹ upon the cat are of great importance in the following discussion. This author supplied the coronary arteries with an artificial blood current and measured the rate of flow from the veins. It was found that even moderate distention of the ventricular cavities markedly diminished the outflow from the coronary veins both in the quiescent and in the still contracting (but presumably dilated) heart.

Finally, Pratt¹² has established the possibility of maintaining for considerable periods automatic contractions in the cat's heart nourished only by an artificial current of blood either through the coronary veins or the vessels of Thebesius. According to Pratt, "The vessels of Thebesius open from the ventricles and auricles into a system of fine branches that communicate with the coronary arteries and veins by means of capillaries and with the veins—but not with the arteries—by passages of somewhat large size." "These vessels are capable of bringing from the ventricular cavities

⁹ W. T. Porter, "Influence of the Heart-beat on the Flow of Blood through the Walls of the Heart," *Amer. Jour. of Physiology*, 1898, i, 145.

¹⁰ Cf. Howell, "Text-book of Physiology," 1907, 510.

¹¹ Ida H. Hyde, "The Effect of Distention of the Ventricle on the Flow of Blood through the Wall of the Heart," *Amer. Journ. of Physiology*, 1898, i, 215.

¹² F. H. Pratt, "The Nutrition of the Heart through the Vessels of Thebesius and the Coronary Veins," *Amer. Journ. Physiology*, 1898, i, 86.

to the heart muscle sufficient nutriment to maintain long-continued rhythmic contractions. The heart may also be effectively nourished by means of a flow of blood from the auricle back into the coronary sinus and veins. Nutrition through the vessels of Thebesius and the coronary veins contributes to the recovery of the heart from fibrillary contractions and from simple arrest without fibrillation, and affords a reasonable explanation of many cases in which the cardiac tissues have survived for months or even years the closure of terminal arteries long believed to be their sole supply."

Very suggestive to the hygienist and therapist, in this connection, are experiments by Yandell Henderson.¹³ This physiologist studied the volume curve of the dog's heart inclosed in a plethysmograph. He found the tone of the heart to vary definitely with the rate of beat. With a slow beat the heart relaxed greatly in diastole, but the systolic shrinkage was relatively slight, leaving a considerable volume of residual blood within the ventricles. As the rate of beat quickened, the diastolic relaxation became progressively less, while the systolic contraction was more and more complete. The same output of blood per minute might occur with widely different rates of beat. Drawing upon the facts set forth above, we cannot but believe that the variation in the rate of heart-beat involved in the manifold changes of a day's occupation must have very material influence on the self-nutrition of the heart through its gradations of tone. A physiological basis is given for the known salutary effects upon the heart of judicious alternation of exercise and rest.

It is a fundamental fact, which has received physiological demonstration, that mechanical distention of the heart is a stimulus capable both of initiating contractions and increasing their energy. That is, when the cardiac muscle-fibres are stretched, within certain limits, they react by a functional shortening. During the normal circulation of the blood the rate of inflow into the heart varies within certain limits and the blood-pressures within the various chambers are undoubtedly maintained in a certain balance.

Suppose a healthy person were suddenly to engage in unaccustomed, violent physical exercise, the effect upon the blood movement

¹³ Yandell Henderson, "The Volume Curve of the Ventricles of the Mammalian Heart," etc., *Amer. Journ. Physiology*, 1906, xvi, 325.

would be to greatly accelerate the flow into the right auricle while, probably, momentarily increasing resistance to emptying of the left ventricle. The details of normal interdependence of auricle and ventricle are still too imperfectly understood to permit of definite statement as to subsequent events, but it is clear that under the conditions named the right side of the heart as a whole is over-distended. One of two results is now to be expected: either the right ventricle contracts to its normal systolic volume, and thus throws out an increased mass of blood at a corresponding expense of energy, or the ventricle defaults in its duty and allows a less or greater excess of residual blood to remain within its cavity at the end of systole. Such a result would be attended by at least a temporary "dilatation" of the organ. Special evils of this condition will be referred to later; at present it is clear that the walls of the dilated cavity fail to adequately assist by their systolic shrinkage the coronary circulation within them; their nutrition accordingly suffers in proportion to the duration of muscular insufficiency. If the right ventricle is simply overdistended but not overstrained by the excess of blood poured into it, its cavity will be efficiently relieved at systole and the result of its increased amplitude of contraction will be improved nutrition and tendency to hypertrophy of its walls. It is a familiar experience that even the slightest excess of muscular exercise in persons of sedentary life leads to functional disturbances of an intensity proportional to the exertion. These perturbations are the result of incoördination in a very complex series of physiological events of which the action of the right ventricle is but a single, though important, factor. By a proper course of physical training the nutrition of the individual tissues may be so improved and their coördinations developed that the range of physiological response to the stimuli imposed is greatly increased.

Of late years much research has been devoted to determination of criteria for the functional efficiency of the heart. These efforts have been concerned especially with the study of the variations of arterial blood-pressure, depending immediately upon the action of the left ventricle, following physical exercise. In the experience of the writer a study of the reactions of the *right* side of the heart presents unequalled advantages for the estimation of the "range of physiological response" of the heart. The right heart is the weaker

organ; it receives immediately an afflux of blood proportionate to the intensity of exertion, and any method which gives knowledge of the amount of intracardiac pressure in the right auricle and of the variation of this pressure under conditions of rest and exercise would seem peculiarly fitted to disclose the state of efficiency of the whole organ. The excellent method of Gaertner¹⁴ for estimation of the right intra-auricular blood-pressure should be put into routine clinical practice. The patient, with chest bare, sits upright. One of his arms, with the hand prone, is semi-flexed and lifted by the observer until a vein on the back of the wrist is seen to collapse. The level, projected on the body, at which this collapse occurs marks the height of the blood column which represents the pressure within the right auricle. The point of no pressure within the auricle may conveniently be assumed to be behind the inferior sternocostal angle. In the healthy person the vein usually collapses at about the third costal cartilage. Gaertner advises inspection of veins on the back of the hand, but for structural reasons these do not usually collapse so readily as the veins of the wrist.

A very satisfactory method of detecting insufficiency of the right side of the heart depends upon behavior of the external jugular veins—especially that of the right side—following physical exertions of varying degree. In the erect posture this vein is normally not visible, but when the heart has reached an advanced stage of debility very slight exertion, such as lifting an arm, may cause it to fill up. When the patient lies semi-recumbent the turgidity of the external jugulars readily announces slight degrees of cardiac incompetence, and when the vein remains full below the site of finger-pressure applied at its middle, thus cutting off the blood from above, the evidence of cardiac incompetency is all the more emphatic. This investigation should include the effects of various physical exertions.

It may not be out of place here to dwell upon a method of estimating the combined cardiac-vasomotor efficiency by measurements of the arterial blood-pressure. In real life the contractile functions of heart and blood-vessels are interdependent. When the heart muscle is degenerated we may confidently look for what may be

¹⁴ Gaertner, *Münch. med. Wochenschr.*, 1903, Nr. 47.

called a brittle vasomotor control. T. C. Janeway¹⁵ has clearly pointed out that most sudden deaths from so-called "heart-failure" are not due to syncope at all, but to vasomotor failure, the heart stopping because the blood which should reach it stagnates in the dilated abdominal veins. Such casualties are liable to occur when the patient suddenly sits up. Especially dangerous is the act of defecation in a sitting posture. Fainting at stool is an exceedingly common occurrence, of little vital moment when the organic structure of the circulation is sound, but liable to be fatal when this structure is degenerated. In the normal subject the systolic arterial blood-pressure is about the same whether taken in the erect or the recumbent position; the tension of the abdominal wall and tone of the abdominal vessels compensate the hydrostatic difference affecting the blood-flow to the heart in the two positions of the body. But when the abdominal wall is flaccid and the tone of the visceral vessels is weak the blood collects unduly within the abdomen in the erect posture and the arterial pressure is lowered. When the supine position is assumed the influence of gravity no longer resists the onflow of blood to the heart, and the arterial pressure rises, sometimes 20 mm. of mercury. I have learned to look on persons suffering from myocardial disease and presenting this display of blood-pressure as especially liable to sudden death.

To the clinician the state of the heart becomes of interest only when the organ fails to respond effectively to the burden thrown upon it and it becomes overstrained and dilated. This catastrophe, which very easily involves hearts which are undertrained and underfed by reason of disuse or whose tissues are degenerated as a result of disease, assaults the truly normal organ with surprising infrequency. Nature has provided in several directions against overstrain of the weak right ventricle. Sudden and powerful muscular efforts probably do not normally throw a dangerous excess of blood into the right side of the heart. On the contrary, during such exertion we instinctively close the supraglottic opening by bringing together the ventricular bands;¹⁶ we contract the expiratory muscles, and thus not only render firm the thoracic fulcra of the bony levers,

¹⁵ T. C. Janeway, *New York Med. Journ.*, 1907, lxxxv, 193.

¹⁶ Cf. Brunton and Cash, *Journ. Anat. and Physiol.*, 1883, xvii.

but compress strongly the thoracic viscera. The flow of blood into the right heart is thus materially reduced. On the other hand, there is no reason to believe that there is simultaneously any material increase of pressure in the pulmonary artery to impede the opening of its semilunar valves. Physiological experiment has made clear that the arterial blood-pressure curves in the systemic and pulmonary circuits are practically independent. The mean pressure in the latter channel in man is estimated at one-fourth to one-third that in the former. The maximal and minimal pressures in the systemic arteries may normally vary within very wide limits, but such alterations do not affect the pulmonary arterial pressure. Accordingly, the great rise in aortic pressure which may attend muscular exertion does not add to the burden of the right ventricle, but, on the contrary, probably leads to improved nutrition of the heart through the increased tension in the coronary circuit. Moreover, Porter and others have shown that the establishment of the coronary circulation in the excised heart is in itself a sufficient stimulus to establish automatic contractions in the organ. Furthermore, there is probably in the normal individual never a critical increase in the low pulmonary arterial pressure. This is efficiently guarded against by the extraordinary distensibility of the close capillary network of the lungs. The capacity of this reservoir is so great that it is said the circulation may be suddenly blocked in the whole of one lung without materially changing the blood-pressure in the pulmonary artery. It is a familiar experience with the clinician to find a patient carrying a massive hydrothorax or enduring an extraordinary degree of pulmonary collapse without evidence of circulatory disturbance. However, both in health and disease contingencies often arise in which the right side of the heart is surcharged with blood beyond the power of the ventricle to relieve itself in the forward direction. Physiological examples of such a condition are probably to be found in untrained persons during long-continued exertion, and in some who venture to unaccustomed altitudes above the sea level. Pathological illustrations are familiar in cases of back pressure from valvular defects or morbid blocking of the pulmonary blood circuit. T. Wilkinson King¹⁷ has shown reason for

¹⁷T. Wilkinson King, "An Essay on the Safety-valve Function of the Right Ventricle of the Human Heart," *Guy's Hosp. Reports*, 1837, ii.

believing that the right ventricle is provided with a "safety valve" action against overdistention. The tricuspid valve is supported by a muscular ring which is capable of easy expansion to a degree which makes the valve "relatively insufficient," so that the excess of ventricular contents is forced at systole back into the right auricle. This chamber, of course, is readily overcharged; but as its supply normally comes to it from a reservoir with a low head of pressure and with a capacity greater than the total blood volume, the veins of the liver and splanchnic system, the excess of blood rejected by the ventricle is stored within these channels.

In another place I have referred to clinical evidences of a safety-valve action of the mitral as well as of the tricuspid valve. None can doubt the conservative influence of mitral regurgitation in a heart so dilated that the valve becomes "relatively insufficient." But I think it probable that this safety regurgitation need not wait on the dangerous stage of extreme dilatation. In a large class of so-called normal hearts there is a reduplication of the first sound at the apex when the subject is in the erect position, but lying supine the reduplication disappears and is replaced by a soft systolic murmur. Such reduplications are probably signs of incipient functional cardiac inefficiency, and it is worth suggesting that the murmur heard is evidence of regurgitation and of a relief of the left ventricle from overstrain. Attention may again be called to the enormous distensibility of the pulmonary vascular reservoir by means of which it can accommodate without distress an extraordinary backflow from the left auricle.

We are now in a position to understand, to a degree, that wonderful experience so familiar to the clinician, the recovery of a heart from extreme stages of broken compensation. In such a condition we may picture the auricles as distended sacs stretched beyond the power of contraction. The ventricles are overstrained and their contraction but slightly relieves the dilatation. The auriculoventricular valves are insufficient and the ventricular outflow is forked, passing backward as well as forward. The blood continually entering the right auricle cannot be expelled in equal degree by the weakened left ventricle; the heart and lungs become progressively surcharged with a burden which, so far from being relieved by leakage through the vascular walls, probably finds the vital reactions of the living

cells impeded by the resulting œdema. The oxidizing function of the lungs is compromised and every tissue suffers. But a feeble nutritive current can find its way through the distended heart walls, and the prime moving force of the coronary circulation—the systolic squeeze upon its contents—is continually failing. Every new event is a new trouble, and death is the inevitable outlook. Now, by certain remedial measures—it may be relief of the right side of the heart by venesection or of the left side by vascular dilators, or by artificial urging of the whole heart to greater contractile effort—let us suppose that the ventricles are induced to carry out a few complete systoles. The cardiac muscle and nerve are thereby fed and refreshed to new vigor; the propulsion of the blood has reduced the burden to be moved, and with each contraction the ratio of power to load increases until full compensation is established.

VISCERAL HEMORRHAGE IN THE NEWBORN

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ONE of the most complex and interesting obstetric problems of the present day is the relation between the metabolism of mother and fœtus. Recent studies in the changes in the maternal organism following conception show that, so soon as pregnancy begins, important modifications occur in the relation of the mother's blood to that of the child as a consequence of developing fetal metabolism. An investigation of this phenomenon has given us a valuable method of diagnosis in early pregnancy in Abderhalden's serum diagnosis of the woman carrying a child.

This consists essentially in testing the blood of the mother to ascertain its reaction to an extract of normal placenta, and the recognition of this reaction constitutes a reliable sign of early gestation.

In the study of the complex phenomena leading to eclampsia, attention has long been directed to the relation between the toxæmic condition of the mother's blood and its effect upon the fœtus. Conversely, fetal metabolism and the discharge of its products into the maternal blood are recognized as one of the causes of maternal toxæmia and eclampsia. Few mothers pass through pregnancy without toxæmia of greater or less development, and while we have no means of recognizing this condition, unless severe, in the unborn child, we frequently observe a transient toxæmia in the newborn infant.

The familiar clinical phenomenon known as icterus in the newborn, which consists in the partial dissolution of blood- and bile-pigments and their absorption, must be considered as toxæmic in nature. The clinical proof of this is found in the fact that the condition yields most promptly to irrigation of the intestinal tract and the instillation of a moderate quantity of diluted saline fluid. In severe cases jaundice in the newborn may develop into a condi-

tion of fatal severity. Following this, extensive dissolution of the blood occurs with petechial eruption, discharges of dark prune-juice and coffee-ground fluid from the intestine, the establishment of fever and coma, with death. This, however, develops gradually, and in some cases can be traced distinctly to a septic condition in the mother.

There remains a certain class of cases in which the infant dies soon after birth without the usual symptoms of icterus, and presenting no definite clinical picture. Only such cases as come to autopsy throw light upon this condition, and the writer's opportunity to examine two such cases in which the metabolism of the mother had been studied during pregnancy suggest to him the publication of his observations.

Case I came under treatment in 1909. The mother, aged 27, a slender, ill-shaped brunette, and of nervous temperament, had been operated upon successfully for appendicitis, and gave a history of attacks of jaundice with symptoms suggesting involvement of the gall-bladder. After her recovery from appendicitis she had spontaneous abortion of unknown cause. A successful pregnancy had terminated shortly before the case was seen in normal parturition. During early pregnancy she had been greatly nauseated, had suffered from habitual constipation, and at the seventh month had symptoms of renal stone or pyelonephritis in the left kidney.

Labor was a few days premature, and the child in breech presentation. The infant was of average weight and development, and its easy birth precluded the possibility of birth injury. The placenta was not normally expelled, and required removal with the gloved hand. The puerperal period was aseptic, the mother's milk deficient in fat and proteid, and the supply failed. The child's meconium was sluggishly discharged, and the urine was brick-dust in color. The child lost progressively in weight, its stools containing curds and dark-green mucus, and areas upon the skin were reddened, resembling the first stage of eczema. On the fourth day the child's temperature was 101° F., rising to 103° and 104°. It had no convulsions.

When seen in consultation with its attending physician the child was evidently toxæmic, irrigation of the bowels producing a discharge of dark-green material with mucus.

Examination of the blood showed red cells 6,730,000, leucocytes 34,200, hæmoglobin 78 per cent. The blood-serum was extraordinarily viscid, and the blood flowed with great difficulty. A diagnosis of toxæmia was made, and treatment proved unavailing, the child dying about three weeks after birth. It had gained during the last week of life, and was taking breast-milk.

On examining the mother some time after her convalescence it was found that she had made a good recovery, so far as the genital organs were concerned. Her general health improved somewhat, and she led an outdoor life, followed by considerable gain. She was, however, habitually constipated, fond of a highly nitrogenous diet, and subject to attacks of hepatic insufficiency.

About a year afterward she again came under observation, supposing herself pregnant, and being then under the care of a medical specialist who was paying especial attention to the condition of the stomach and intestine. She was very desirous of a living child, and passed the remaining months of gestation living quietly where she could be out of doors and in company with a nurse who supervised her diet. During this time she was upon a restricted diet, but it was difficult to limit the quantity of food taken, as the patient had an excessive appetite and had difficulty in taking milk.

Repeated examinations of the urine showed no evidence of nephritis, but the specific gravity and the output of nitrogenous waste were below normal. The patient's tongue was coated much of the time, but her condition otherwise seemed fairly good. The pulse tension was normal.

As pregnancy drew toward its close the patient had severe attacks of hepatic insufficiency, relieved by active purgation and restricted diet. Shortly before labor the ammonia nitrogen was in excess, and the creatinin and rest nitrogen also much above normal. The urea nitrogen was deficient, but there was no albumin and there were no casts. The quantity of urine was the average.

At term she gave birth spontaneously, without difficulty, to a male child weighing 9 pounds 4 ounces. In view of her first experience, it was decided that she should not nurse the child, and her recovery from labor was uncomplicated. The child for the first five days did well upon diluted milk, intestinal irrigation, and a free supply of water. On the fifth day its temperature rose to 102° F.,

it was sluggish, and breathed irregularly. It gradually failed to take nourishment and had attacks of cyanosis, although the action of the heart remained fairly good. The transverse colon was somewhat dilated, but there was no general intestinal paresis.

With modified diet and stimulation, the child gained slowly until the twelfth day after birth, when its temperature rose to 103° and 104° F., and it had vomiting of blood and bleeding from the nose. The cyanosis disappeared. After apparent improvement it was suddenly seized with profuse hemorrhage from the nose and mouth, the blood being bright red, followed by death.

Autopsy was performed as soon as possible, and the body showed a slight emaciation. The thymus gland was not enlarged, the heart muscle somewhat pale but firm, the stomach and cæcum moderately distended, the remainder of the intestines collapsed, and the peritoneum normal. The lungs showed numerous very dark-red or black patches, the spleen was intensely dark-red in color and very firm, the adrenals, kidneys, bladder, and thyroid were normal. There was no hemorrhage in the stomach. The liver showed many dark-red and almost black areas resembling those in the lungs. The biliary passages were open. The gall-bladder contained an almost colorless fluid; the pancreas and intestines were normal, the brain exceedingly soft, the hypophysis normal, and also the spinal cord.

Inoculations were made from the various organs, and special stains were employed for bacteria, for the *Treponema pallidum*, or fatty degeneration, and for the central nervous system.

On microscopic examination the dark areas in the lungs were found to be recent hemorrhage. The blood-vessels of the thymus were unusually well filled with blood, as were the adrenals. In these bodies were multiple, though not numerous, areas of hemorrhage and necrosis. The kidneys showed swelling of the tubular epithelium with distention of the vessels.

The most marked changes, however, were in the liver. There were areas of necrosis from one to several lobules in extent, and often irregular in outline, without uniform distention. Necrosis was in some instances complete, and in others but partial. Red blood-cells were abundant in and about the necrotic areas. At least one-third of the liver was occupied by areas of hemorrhagic necrotic change. Granules of yellowish-brown pigment were numerous in

these areas and in other portions of the liver. Normal liver-cells were not to be found. Sections treated by osmic acid showed that practically all of the cells were necrotic and contained numerous fat globules of various sizes. Stained sections showed in some of the necrotic areas small bacilli corresponding to those isolated from cultures made. *Treponema pallidum* was not present.

The cells of the pancreas were swollen and granular, and in some portions of the thyroid there were colloid areas. The parathyroids were normal. There was no essential lesion in the nervous system. Inoculations from the blood in the right ventricle, from the spleen and liver, each gave rise to a luxuriant growth of the bacillus pyocyaneus in pure culture.

The pathological study of this case was made by Professor A. G. Ellis, of the Pathological Department of the Jefferson Medical College. The clinical phenomenon of striking interest in this case was the sudden death of the infant from bright pulmonary hemorrhage, the blood welling up through the nose and mouth in an alarming quantity. It had been recognized for some days that the child was suffering from acute toxæmia of unknown origin. The food given to the child was sterile, and, as the mother's puerperal period and pregnancy had been aseptic, so far as the genital tract was concerned, there was no recognizable source for the infection. In view of the pathological findings, it seemed rational to believe that the child's infection and toxæmia were the consequence of the mother's condition of hepatic and intestinal insufficiency, and that her complete recovery to health and the possibility of a future successful pregnancy would depend upon such medical or surgical treatment of her digestive tract as might be found necessary after her recovery from childbirth.

Case II was that of an infant born from a mother twice married, who during her first pregnancy gave birth to a fairly-developed and fairly-nourished female child. The following pregnancy terminated in acute toxæmia, with loss of vision which had been largely regained. Hemorrhage into one eye had left some permanent damage.

In the second marriage there had been a spontaneous abortion at four and a half months. The pregnancy in question was characterized by chronic toxæmia. Efforts were made to restrict the diet, but such efforts were but partially successful, as the patient

wearied soon of any form of diet. A strictly milk diet proved impossible. Under precautions the urine remained practically normal, so far as the ammonia nitrogen went, but the creatinin and rest nitrogen were repeatedly above the average. It was difficult to secure the taking of sufficient water; faintly granular casts were occasionally present in the urine, with a trace of serum albumin. In spite of a persistent effort to regulate the patient's diet and hygiene, the diet was a matter of great difficulty, and the patient was subject at times to great mental strain and disturbance.

At between the seventh and eighth months of pregnancy, an examination of the eyes revealed the fact that the vessels of both eyes were in good condition, without dilatation or hemorrhage, and that no sign of albuminuric retinitis was present. It was evident that in the previous toxæmias there had been a cerebral hemorrhage, which left a scotoma in the nasal field of the left eye. The ophthalmologist reported that hepatic toxæmia was evidently present, but without nephritis, and that the patient should receive treatment for this condition.

Shortly after, following severe mental and nervous disturbance, slight hemorrhage from the vagina occurred, followed by spontaneous birth in breech presentation of a female child, 16 inches long. The cord beat strongly, but the child breathed with difficulty and was gradually resuscitated. The child was at once placed in an incubator, and soon after birth passed urine and meconium. It was able to cry and to swallow. Repeated attacks of deep cyanosis developed, but yielded to artificial respiration. One of these attacks, about thirty hours after birth, proved fatal. The mother made an uninterrupted recovery under a restricted diet. Her urine at first showed deficient nitrogenous metabolism, but this gradually improved. There was no evidence of nephritis. There was great mental and nervous disturbance following labor, with some general œdema and jaundice which gradually subsided.

On examining the placenta, its substance contained areas of degenerate or necrotic villi in which the endothelium of the vessels was swollen and the blood-vessels had been replaced by cells. The syncytium was present surrounding these areas. The general appearance was that of angiomatous villi. There was no evidence of the presence of the *Treponema pallidum*.

The umbilical cord showed no important lesions. The child, a female, was 40 cm. long, and not well nourished, with very slight jaundice. There was very slight rigor mortis, the right hand being cyanosed, the left less so. The adipose tissue was abnormally bright yellow in color, and on opening the abdomen the peritoneum contained 100 c.c. of blood. On the lower surface of the left lobe of the liver was a subcapsular hæmatoma in which the blood was partly clotted. Through a slight rent in this capsule blood had escaped into the peritoneal cavity.

The colon and lower part of the small intestine were filled with meconium. In the thymus there were small reddish areas, suggestive of extravasation of blood. The pleuræ and pericardium were normal, the heart slightly pale and slightly soft, the valves and great vessels normal, and the ductus arteriosus was patulous. The foramen ovale was largely closed by a thin membrane. Microscopically there were areas of well-defined fatty degeneration in the fibres of the heart muscle. The lungs were reddish-gray in color, contained air, and the vessels were filled with blood. The *Treponema pallidum* was not found.

The thyroid and other structures of the neck were normal, and microscopic study of the thyroid showed no evidence of colloid degeneration. The spleen showed no gross lesions, was rich in blood, with many pigment granules. Inoculations from the spleen were sterile. In the left adrenal there was an area of hemorrhage, which on microscopic examination was found occupied by red blood-cells, the granular structure having disappeared. The right adrenal was normal.

In the kidneys the tubular epithelium was moderately swollen and granular. The ureters, bladder, internal and external genital organs were normally developed and normal in condition. The stomach contained a small quantity of fairly viscid, pale-yellowish mucus, and the tubules of the mucous membrane of the stomach were normal. The gall-bladder was fairly well filled with pale-yellow bile, and the biliary passages were patulous.

Microscopically, the liver-cells were granular and when treated with osmic acid showed numerous small fat droplets. The capillaries contained excessive blood, with small collections of leucocytes between columns of liver-cells. These stained very deeply. There were

no areas suggesting infection. The liver was sterile, but the area beneath the capsular hemorrhage showed degeneration and hemorrhage. The *Treponema pallidum* was not found.

The pancreas, intestines, and large vessels of the abdomen appeared normal, and the lower end of the left femur showed a normal line of epiphysial junction. There was a small quantity of blood-tinged fluid beneath the scalp and beneath the dura mater. The brain was exceedingly soft and the spinal cord showed slight fatty changes in the sheaths of the fibres. The hypophysis was soft and rich in blood. The essential lesions found in the infant were granular and fatty degeneration, congestion, pigmentation, leucocytic infiltration, and subcapsular hæmatoma of the liver, with hemorrhage into the abdominal cavity.

The pathological examination in this case was made by Professor A. G. Ellis, of the Pathological Department of the Jefferson Medical College.

These cases resemble strikingly four reported by Bonnaire and Durante (*L'Obstétrique*, October, 1911). They cite similar cases reported by Hodge (*American Journal of the Medical Sciences*, 1870), in which fatal hemorrhage occurred from the liver in an infant two and a half days old. Woodward and Lamb (*Washington Medical Annals*, No. 1, 1902) report two cases of subcapsular hepatic hemorrhage in the newborn, and Lequeux (*Thésis*, Paris, 1906) reports eight cases of hepatic hemorrhage causing death in the newborn. In Cathala's case, cited by Lequeux, the hemorrhage had accumulated beneath the capsule of the liver, resulting finally in abdominal hemorrhage.

Bonnaire and Durante's first case was that of a primipara with albuminuria and eclampsia, the child being delivered by forceps. The child breathed feebly and irregularly at birth, remained pale, and its circulation and respiration were not normally established. It died about thirty hours after delivery.

At autopsy the abdominal cavity was filled with liquid and clotted blood whose origin was the right hypochondrium beneath the right lobe of the liver. On this portion of the liver was an area 4 cm. in length, where the capsule of the liver had been ruptured by a copious hemorrhage. The thymus and suprarenals also showed evidence of hemorrhage. On examining the liver, degeneration of

the liver substance and hepatic hemorrhage were found in the infected area.

In the second case little was known concerning the condition of the mother, as the child died soon after its admission to the hospital. At autopsy, coagulated blood was found in the abdomen, the source of the bleeding being the right lobe of the liver, where hepatic hemorrhage had occurred, followed by a rent in the capsule of the liver. On examination, at the site of rupture, the parenchyma of the liver had undergone extensive degeneration.

The third case was that of a primipara who gave birth prematurely to a child dying on the following day. Abdominal hemorrhage in the infant was traced in this case to the liver, where a similar condition to that already described was present. The capsule of the liver had been separated from the gland and slightly ruptured. The hepatic cells had undergone extensive degeneration.

The fourth case was that of a multipara who had had six normal labors and who was suffering from cancer of the stomach. She had albuminuria and the general depression which accompanies malignant disease. The child was at nine months' development and spontaneously born, and upon autopsy abdominal hemorrhage was present.

On the superior surface of the liver there was a profuse hemorrhage, which had distended and separated the capsule at one point, in which rupture had occurred. Microscopic study of the liver substance showed parenchymatous degeneration and infiltration of blood. There were hemorrhages into the kidneys and suprarenals in this case.

In studying the cause of this condition, one may first eliminate traumatism and birth pressure. It is notable that this complication arose in cases where labor was spontaneous, rapid, and often remarkably easy. Contracted pelvis is reported in none of the cases, and in none of them was labor prolonged. In none of the cases was manipulation of any sort employed which would cause injury to the infant, nor was there any occasion to disturb the child excessively.

Syphilis at once suggests itself as the cause of the condition, but in the two cases first reported in this paper syphilis could absolutely be excluded by bacteriological examination. That it may be present in some is shown by cases reported by Behrend (*Annali di Derma-*

tologie, 1866), Kassawitz (*Centralzeitung f. Kinder* 1878), Bumstead and Taylor, Boissard (*Proceedings of the Obstetrical Society of France*, 1899), and Ausset and Derodde (*Proceedings of the Congress at Leille*, 1900); Sacquepée (*Proceedings of the Anatomical Society of Paris*, p. 444, May, 1899) reports the case of a woman, 44 years old, who had had syphilis which had not been treated efficiently. Alcoholism was absent. She had sustained no traumatism.

Shortly before coming under observation she had a fracture of the leg which healed without complications. Some time after she was taken with severe headache and constipation, followed by violent abdominal pain with colic, nausea, and vomiting. Intestinal obstruction was diagnosticated. In the next few days she improved somewhat, but suddenly died. Upon autopsy a very profuse abdominal hemorrhage was present which could be traced to the under surface of the liver, while an area of parenchymatous degeneration was present, the hemorrhage having ruptured in the capsule of the liver. Although this case is reported in an adult, it seems to illustrate the possible effect of neglected syphilis.

Griffon and Nattanlarrier (*Proceedings of the Anatomical Society of Paris*, October, 1902, p. 859) report an interesting experiment in which cerebrospinal fluid in a case of tubercular meningitis, but containing no pyogenic microbes, was injected into the peritoneal cavity of a full-grown rabbit. Sudden death followed, and upon autopsy there was profuse abdominal hemorrhage traced to parenchymatous degeneration of the liver, with rupture of the capsule.

Bonnaire and Durante concluded, from their study of the subject, that these cases must be traced to a chronic inoculation or infection of the mother, producing vascular lesions and cellular degeneration in the liver of the child, which diminished the formation of fibrin and lessened the coagulability of the blood. At the moment of birth this condition produces leucocytosis and congestive phenomena. The degenerate vessels give way under increased congestion, and hepatic hemorrhage follows, the blood accumulating beneath the capsule of the liver, which finally gives way. They note the fact that manipulation and pressure from traumatism are absent in all cases.

As regards infection, they raise the question as to whether the ever-present bacillus of influenza could have been the predisposing cause in these cases. During the time that these patients were observed, Paris suffered from an epidemic of influenza which affected both children and adults.

Baldissari (*Gyn. Rundschau*, Band 5, p. 682, 1911) reports sudden death in the newborn, with hemorrhage from the ears, nose, mouth, and anus, caused by melæna. On section minute hemorrhage was found in the mucous membrane of the stomach near the cardiac orifices, also in the brain from what seemed to be old thrombi, while the vessels in all the organs were thickened but without evidence of infiltration. The liver was markedly hyperæmic, but there was no hepatic hemorrhage and no abdominal hemorrhage.

Röther (*Deutscher m. Wochenschrift*, Band 37, p. 545, 1911) reports a case of Buhl's disease of severe infection in the newborn and uncontrollable hemorrhage from the umbilicus. Staphylococci in pure culture were obtained from the blood. The mother had fever four days before confinement, which indicated that the child had become infected before birth, and that the umbilical hemorrhage was a phenomenon secondary to a general infection.

Sprague (*British Medical Journal*, vol. ii, p. 687, 1911) reports fatal hemorrhage from the stomach in a newborn infant. Upon autopsy two eroded surfaces on the posterior wall of the stomach were the source of the hemorrhage.

Wells (*Boston Medical and Surgical Journal*, May 18, 1911) reports the case of a newborn infant in whom, twelve hours after birth, extravasation of blood occurred in the scrotum with severe bleeding from the nose, followed by a fatal termination.

The literature on the subject of hemorrhage in the newborn is extensive and contains repeated examples of melæna from general infection. Cases, however, where some portion of the digestive tract has been the site of hemorrhage are not abundant.

Wolfsohn (*Inaug.-Dissert.*, Leipsic, 1900) reports a fatal case of melæna, where autopsy showed a large ulcer in the duodenum as the site of hemorrhage. No general condition was found which accounted for the occurrence of the hemorrhage.

Schmorl (*Archiv. f. Gynäkologie*, Band 25, p. 408, 1901) reports five cases of melæna, in two of which there was no microscopic

lesion in the intestinal tract, but fatty degeneration in the walls of the small blood-vessels. This was undoubtedly due to an altered condition of the blood. In one other case there were ulcers in the stomach, and in one ulcers in the duodenum, for which the only assignable cause was thrombosis of the small arterial vessels. In these cases infection with the colon bacillus was undoubtedly present, and in two there was purulent inflammation of the ductus choledochus with thrombosis.

These cases suggest the part played by the colon bacillus in the hepatic hemorrhage reported in the two cases described in this paper.

Meyer (*Inaug.-Diss.*, Zürich, 1902) reports a case of fatal hemorrhage where ulcer of the œsophagus was the point from which the hemorrhage occurred.

Saxer (*Deutscher med. Wochenschrift*, Band 28, p. 211, 1902) describes a fatal case of melæna with a large ulcer of the duodenum.

The fact that hemorrhage in the newborn rarely occurs from the liver in comparison with hemorrhage in various portions of the nervous system is illustrated by Couvelaire (*Annal. de Gynecol. et d'Obstétrique*, vol. lix, p. 253, 1903). In 51 autopsies on newborn children, he found 11 cases of hemorrhage in the central nervous system, but in none of these cases was there hemorrhage from the digestive tract. Many of these had been delivered by forceps, and all had been subjected to considerable pressure during parturition.

Bauer (*Münchener med. Wochenschrift*, vol. li, p. 1207, 1904) describes three cases of death from hemorrhage, in one of which there was congenital stenosis of the duodenum, and in one hemorrhagic erosion of the mucous membrane of the stomach, with embolism of the abdominal vessels. No mention, however, is made of the condition of the liver.

Lequeux (*L'Obstétrique*, vol. xi, pp. 97 and 530, 1906), in 2162 newborn children, had 41 cases of external and internal hemorrhage, with 36 deaths. In many of the cases a maternal toxæmia from different causes was thought to have produced fatal disease and death. Infection of various sorts, especially that of the colon bacillus, could also be traced. Some of the mothers had pyelonephritis during pregnancy. In the fœtus lesions were found in the liver and spleen, the blood was greatly altered, and its fibrin much diminished. Toxic blood produced lesions in the vessels and vasomotor paralysis as well.

Ipsen (*Zentralblatt f. Gynäkologie*, Band 31, p. 1359, 1907) describes a most interesting case of fatal hemorrhage in a prematurely born child, arising beneath the capsule and in the substance of the pancreas, with bleeding in the mucous membrane of the duodenum.

Nauwerck and Flinzer (*Münchener med. Wochenschrift*, Band 55, p. 1217, 1908) describe a case of death from hemorrhage with necrosis of the mucous membrane of the stomach, swelling of the spleen, and cholecystitis. The child had also otitis media. From the blood were isolated the paratyphus and colon bacilli, and the infection could be traced through the placenta from the mother, originating in the paratyphus infection, and becoming mixed infection by the addition of the colon bacillus. It is interesting to observe that in these cases cholecystitis was present.

Vassmer (*Archiv. f. Gynäkologie*, Band 89, p. 275, 1909) reports 67 cases of melæna neonatorum with 22 deaths. Among these were two of stenosis of the duodenum, and 12 with ulcer of the œsophagus, stomach, duodenum, or ileum. In one of these cases mixed infection with the colon and paratyphus bacilli was present.

Young (*Boston Medical and Surgical Journal* vol. clxii, p. 47, 1910) reports the death of a child with subcapsular hemorrhage from the liver. The child was born in breech presentation. It does not appear from the paper that the birth was especially difficult or that the child was subjected to unusual pressure.

Baldissari (*Gyn. di Rundschau*, Band 5, p. 682, 1911) reports a fatal case of hemorrhage from the ears, nose, mouth, and anus. On section, small punctiform loss of substance with hemorrhage was found in the mucous membrane of the stomach near the cardiac orifice, with old thrombi in the brain, great hyperæmia of the liver, and thickening of the arterial coats in all of the large viscera of the body. Toxæmia was evidently the cause of the condition.

Sprague (*British Medical Journal*, vol. ii, p. 687, 1911) describes a case of fatal gastric hemorrhage in a newborn child with erosions on the posterior wall of the stomach.

The literature affords abundant examples of hemorrhage from the liver which could be traced to thrombosis with lesions in the stomach, duodenum, spleen, and œsophagus.

We must again emphasize the fact that, while these cases are

not infrequent, they are far less often encountered than hemorrhage into the central nervous system. It is only in cases of extreme pressure or great mechanical violence that hemorrhage into the liver can be traced to this cause.

The picture in the condition described is distinctly that of a toxic blood state producing embolism and thrombosis, with altered condition of the blood, minute areas of necrosis, the breaking down of vessels, and hemorrhage. While in the cases reported in this paper a toxæmic condition in the mother can be clearly traced as the cause of fetal hemorrhage, in many reported cases no mention is made of the maternal state. It can, however, be concluded that toxæmia in the mother certainly predisposes to hemorrhage in the child, and in the interests of the child calls for efficient treatment.

While maternal toxæmia can often be controlled to such a degree that the mother's life may be spared, it is much more difficult by such treatment to increase the chances of the child for life. Herein lies a field for advance which gives promise of success. As the study of the maternal blood is perfected, and also the reactions between the blood of the fœtus and the mother, we may arrive at a satisfactory method of preventing fetal toxæmia by curing the toxic condition in the mother by the injection of serum.

The treatment of pernicious nausea of pregnancy by the injection of serum from the healthy individual has been sufficiently successful to encourage us in the belief that this may ultimately be used in the interests of the fœtus. In the present state of our knowledge, progress seems to lie in this direction. If the child is born living and is evidently suffering from hemorrhage, the direct transfusion of blood may, if possible, be undertaken.

Lespinsse and Fisher (*Surgery, Gynecology and Obstetrics*, No. 1, 1911) report six cases of hemorrhage in the newborn treated by transfusion, with the instant control of the hemorrhage. Three cases, however, died, of which one was syphilitic, the other death resulting from a lack of coagulating power in the blood, or from septic infection. If possible, the blood should be taken from the radial artery of the father, and the child watched carefully to avoid overburdening the heart by a too rapid flow of blood. The artery may be joined to the popliteal vein of the child. The amount of blood required is very small, and the effect produced will indicate the

required quantity. The success of the direct transfusion of blood in infants for meningeal hemorrhage and hemorrhage from the umbilicus should encourage a trial of this method in toxæmic newborn children with signs and symptoms of internal hemorrhage. The use of gelatin, while successful in some cases of hemorrhage, does not promise good results in the condition under consideration. The instillation of salt solution into the bowel, while useful in controlling toxæmia, is too slow in action to be beneficial in active hemorrhage. Surgical interference is not indicated, for there is no point from which hemorrhage comes which is susceptible to surgical treatment.

Where the mother has lost several children by this complication, the question naturally arises as to what can be done in her treatment to secure a better result for the child. If the symptoms point to disease of the appendix or gall-bladder, the appendix should be removed and the gall-bladder drained. If repeated examination of the urine indicates that the pelvis of the kidney is the site of infection by the colon bacillus, urotropine, milk diet, and salines should be employed until the urine becomes normal. Obstinate constipation should be treated by laxatives and repeated thorough colonic flushings. A selected diet, largely of milk, is indicated. Intestinal antiseptics have not proven successful in preventing lesions of the liver, and one can scarcely rely upon them in preventing disease in the *fœtus*.

ISOLATION ROOMS IN RESIDENCES FOR CARE OF PATIENTS SUFFERING WITH CONTAGIOUS DISEASES

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AND

MEYER J. STURM, B.S.

Hospital Architect

THE wisdom of providing isolation rooms, preferably in the upper story of residences in which there are young children, has been frequently suggested. In many cities the authorities prevent the healthy children from going to school if one member of the family suffers from a contagious disease, and in some instances the father of the family is not permitted to go to his business if he lives at home. All of these regulations are eminently proper, because they seem to protect the community at large. However, they often work a hardship upon the family afflicted and one which could easily be eliminated if the residence were provided with properly-planned isolation rooms.

Isolation rooms would, of course, also serve to protect the remaining members of the family more thoroughly than can otherwise be done even with the greatest care. Until recently not one of our American cities has had adequate and proper facilities for the treatment of contagious diseases in isolation hospitals. It is, consequently, all the more important that private residences be properly equipped.

In response to this need we have developed plans which contain all the elements necessary to insure perfect isolation and, consequently, perfect safety. At the same time these plans provide the greatest possible comfort without incurring an unreasonable expense and without reducing the efficiency of the residence in times when there is no sickness.

A study of our plans will show that the total expense of an equipment is nothing compared to the expense of an additional case of contagious disease in the family. Added to this, such complete

isolation will result not only in an economy to the individual family but also to the community at large. Were all cases of contagious diseases occurring in the families of well-to-do people cared for in isolation rooms in their own homes or in private hospitals for the treatment of contagious diseases, and all of the patients in the families of the poor sent to properly-conducted hospitals provided for this purpose by the municipalities, it is perfectly clear that in a very short period of time there would be practically no one suffering from these diseases. This would eliminate the enormous expense in human lives, and the money now expended for the treatment of such patients would in a few years pay for the entire expense of these facilities. Moreover, a great amount of disease resulting from the defects caused by these infectious and contagious diseases would be prevented.

There are, consequently, abundant reasons for giving special attention to the planning of facilities for isolation rooms properly constructed and equipped in private houses.

The fact that most residences have little room to spare has been one of the chief objections to providing for special isolation rooms. Since the introduction of simple and safe methods of disinfecting rooms, together with their contents, by means of fumes of formalin and permanganate of potash this element need no longer be taken into account; because, after the patient has fully recovered, the rooms need to be idle but a few days and then may again be occupied by any member of the family with absolute safety.

There is still a superstition concerning the occupancy of a room in which some one has been ill. This is a survival due to ignorance of the cause of disease at a time when the reasons for contagion had not been established. Now that we are certain that contagion is due to a living organism and that we can destroy this organism, this superstition must soon be a thing of the past.

These rooms may, consequently, be used with perfect safety by any member of the family when no one is ill. They may be utilized as well by any one for a non-contagious disease. They will be especially well suited for obstetrical service in the family; in fact, they will provide a condition almost equal in efficiency to a well-equipped obstetrical hospital. Such a department must provide complete isolation of the patient, together with all the conveniences

for comfort, for sterilization of utensils, for toilet and bath, for cooking simple meals, and for lodging a nurse.

If it is possible, the south end of the house should be chosen for the isolation department, because of the advantage which comes from an abundance of sunlight. However, this is not imperative. In case the north end of the house is chosen, there must at least be windows provided that will give east and west sunlight.

The room A in our plan is to be occupied by the patient. This room should preferably be placed in the southeast or southwest corner, with windows in both directions, and should be equipped with a bed, bedside table, chairs and other fittings customary in an ordinary bedroom.

The nurse's room (D) would be fitted in practically the same manner as the patient's room, closets being provided in both rooms. In both of these rooms provision should also be made for indirect lighting, and, in addition thereto, at the head of each bed there should be either a light or a plug for a lamp. From the patient's room there should be connected with the nurse's room a bell or buzzer so that the patient can call the nurse at any time. This buzzer should have an extension push that can be put on the bedside table and be accessible to the patient.

During the period of sickness the kitchenette (C) should be provided with a small refrigerator (7), with a gas stove (9), sink (8), kitchen cabinet (4), which cabinet is to contain all of the kitchenette utensils for the cooking and serving of meals. All dishes for this department should be of a special pattern or color not in use by the family, in order to prevent carelessness on the part of the attendant who must look after the washing and disinfecting of all dishes and utensils. There should also be provided a table (1) and an incinerite (13). This incinerite can be of a small, inexpensive type operated by gas, as it is in proximity to the gas stove (9), the purpose of the incinerite being to burn all refuse which would otherwise have to be carried out of the infected department.

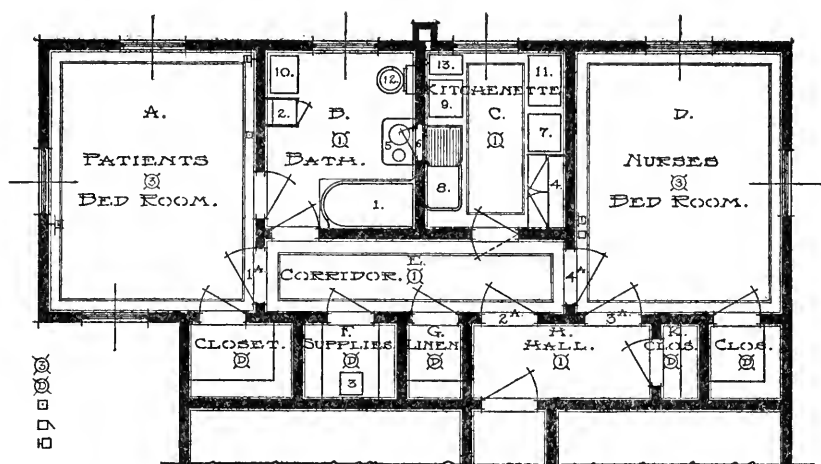
All of the furnishings, including the metal kitchen cabinet, should be of the portable type. Everything can then be taken out of this room and, under ordinary circumstances, the room used as a sewing-room or a dressing-room in connection with the bedroom (D). The sink (8) in this room should be of the ordinary clinic type,

with removable wood drain board, and can be used for lavatory purposes when the department is not being used for isolation.

In the bathroom (B) there should be placed a blanket warmer (2), a utensil sterilizer (10), water-closet (12), a dental lavatory (5), a tub (1), and a medicine cabinet (6). Necessarily the floor in this room should be of tile or some impervious material, and the walls thoroughly enamelled

The portable sterilizer, to be made of metal, white enamelled (10), is to be used for the sterilization of all utensils, except dishes

FIG. 1.



No. 1. Bath-tub.
No. 2. Blanket warmer.
No. 3. Disinfecting machine.
No. 4. Kitchen cabinet.
No. 5. Lavatory.

No. 6. Medicine cabinet.
No. 7. Refrigerator.
No. 8. Sink.
No. 9. Stove.

No. 10. Sterilizer.
No. 11. Table.
No. 12. Toilet.
No. 13. Incinerator.

which go downstairs and which can be boiled in the kitchenette before they are placed in the cupboard or sent out. The blanket warmer (2), to be operated by a small gas or electric heater, is an ordinary galvanized iron closet, white enamelled, with a door having spring hinges and a latch. Its shelves are to be perforated with one-inch holes, so that heat can travel through all of the blankets. It can have a small vent to the roof, to which also may be connected the vent to the sterilizer. The sterilizer (10) is the ordinary type of instrument or utensil sterilizer which can be obtained from manufacturers of this class of material.

The bath-tub (1) should be of the recessed pattern, either of porcelain or enamelled iron; any portion which comes in contact with or in proximity to a wall should be recessed into the wall so there will be no vacant space under or at the back or side of the tub. The tub should be placed upon a base recessed in the tile floor. A shower head-ring and curtain can be placed over the tub. The lavatory is of the pattern known as the dental lavatory, with a wash-basin and a small dental bowl in addition thereto, all to be made of vitreous china in one piece.

If it can be readily arranged, and the water pressure is sufficient for the purpose, the water-closet (12) should be of the wall type, so that as little of the floor as possible should be obstructed by the plumbing and other fixtures in this room. This water-closet should be provided with a swinging flushing jet for the purpose of flushing bed-pans.

The sterilizer and blanket warmer should be on white metal legs, or could be hung to the wall, so that the only fixture in the entire room on the floor would be the tub, and this recessed into the floor and wall as described. There should be no nickel-plated plumbing where plumbing pipes are exposed, but all of white metal, inasmuch as nickel-plating wears off, tarnishes, and is not as satisfactory as the solid white metal.

In addition to the rooms, there is provided a supply closet (F) wherein the disinfecting machine (3) described herein can be placed, and when the department is not being used for isolation this closet can also be utilized for the storage of the blanket warmer, sterilizer, and part of the portable furniture of the kitchenette (C). The clean linens would be kept in the linen closet (G). Provision could be made for a small sliding door from the hall (H) to this linen closet, so clean linen could be brought by the attendant to this room and properly distributed in the closet by the nurse, who would thus not have to leave the corridor (E) for the purpose of taking in the linen. During the isolation period the door (A) should remain locked and all communications between the household and the sick-room should be through hall (H) and door (3A).

Aside from the lighting of the rooms by artificial light as described, the lighting is on the ordinary system, wherein in bathroom (B), kitchenette (C), hall (H), and corridor (E) there is the ordinary light fixture and in all closets a drop cord.

This plan contemplates placing the patient in room A, the nurse in room D, all of the utensils for the toilet and bathroom in B, everything needed for the diet of the patient and nurse in the kitchenette (C). All of the supplies during the period of isolation would be in the large supply closet (F). All clean linen supplies should be placed in the linen closet (G), either in the manner described or they could be brought in by the attendant to hall (H).

The floors in this entire department should be of impervious material, preferably of tile or flake mosaic. The floors may be covered with carpets or rugs, and pictures may be placed upon the walls. In fact, it will not be necessary to remove either pictures or draperies during the period of sickness, because it would require years for infectious material to travel from these to the patient, as none of the infectious micro-organisms can move from place to place independently. But, as these objects are of no advantage to the patient, they might as well be removed when the rooms are changed from living to isolation rooms. It should, however, be understood that the formalin and permanganate of potassium fumes will satisfactorily disinfect all of these objects.

A table should be placed conveniently in hall (H), upon which all supplies are placed which are needed in the isolation rooms. There may be telephone communications with other parts of the house, or electric bells may be installed for signalling, so that it will not be necessary for the nurse to leave the room.

When the nurse goes for a walk she should be covered with a long cloak, which must not come in contact with the patient at any time or with anything which has come in contact with the patient. While out for her airing she must, of course, not visit any shops or enter any residence. All errands must be done for her. There is really little or no danger from contact with such a nurse, but it is well to develop a system which is entirely without flaws from the standpoint of preventing contagion or infection.

The sheets, towels, and blankets that have been used must be sterilized before they are sent to the laundry, and must all be placed in sterilized canvas bags before leaving the sick-room. Only washable clothing or that which can be sterilized with formalin and permanganate of potassium fumes is to be used. An apparatus for developing these fumes is to be provided. When the patient has fully

recovered and has been proven free from infectious germs, he is bathed and provided with sterile clothing in bathroom (B). Then he is transferred to a cot in the nurse's room while room A, bathroom (B), and closets (F and G) are being sterilized by fumigation.

A second entire suit of sterilized clothing for the patient and the nurse are placed in sterile canvas bags and suspended in the closet (F). After the fumes have acted for a sufficient period to thoroughly disinfect everything contained in these rooms, the door (2A) is opened, and also all of the windows in room A and bathroom (B). Then the patient and the nurse both put on their fresh clothing, place discarded clothing in room D, and close the doors (3A and 4A), after having started the apparatus for generating gas for disinfecting room D and kitchenette (C).

They are now ready to be admitted to the family. The following day all the floors, the walls, and the woodwork should be scrubbed with $\frac{1}{2}$ per cent. formalin solution; then all the outside doors and windows should be again sealed and formalin and permanganate fumes again generated, all inside doors being open.

After forty-eight hours the sick-room may be dismantled, the kitchenette transformed into a dressing-room, the sterilizer and blanket warmer removed from the bathroom. All of these utilities can be stored in a closet prepared for this purpose in the garret, and these two rooms will be among the most desirable ones in the house. They may both be used for sleeping-rooms, or either one may be used as a sitting-room or nursery. The sink in the kitchenette may be changed into a lavatory or shower-bath. In the latter case the kitchenette should be provided with a permanent lavatory.

It seems reasonable to expect that health departments would be willing to remove their ordinary restrictions against residences having these facilities for perfect isolation in case of sickness of a contagious or infectious nature, if upon inspection it was found that all the measures indicated above were being carried out.

The plans can, of course, be modified in many different ways in order to suit the general architecture of the house, so long as provision is made for absolute isolation and perfect disinfection of everything that could possibly be contaminated. It might also be an advantage to construct a porch or veranda on one side of the building, provided it would not unduly obstruct the sunlight.

The apparatus mentioned may be as simple or as elaborate as may suit the fancy of the owner, so long as it is efficient.

As before mentioned, these rooms would, of course, be ideal for the care of patients suffering from non-contagious diseases, and also for obstetrical service.

When not in use for the care of sick members of the family these rooms can be made quite as attractive for living- or bedrooms as any other portion of the residence. This plan will consequently result not only in a means of safety but also in an economy to the household.

ALTRUISTIC CO-OPERATION

BY JOSEPH P. REMINGTON, Ph.M., Phar.D., F.C.S.

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How can the pharmacist aid the physician in "preventive medicine"? Physicians have abundant opportunities of observing many acts of the pharmacist in the pursuance of his daily duties which strictly fall within the definition of altruism as defined by the French leader, Comte. The medical profession has been given credit by the general public for many services performed from altruistic motives; and, although these have been misconstrued, and selfish motives have been attributed to worthy and unworthy members of the profession, it is an undeniable fact that many acts of the pharmacist have failed of appreciation, and this from natural causes for which probably no one is to blame.

In order to justify his point of view in life the selfish egotist will not believe that there are men in pharmacy who do many acts of kindness without a thought of pecuniary advantage. Even the selling of postage stamps to the public is considered to be a part of the duties of a pharmacist, notwithstanding the fact that this is usually done at a loss. The United States Government gives no discounts which would enable any citizen to receive any profit directly. The annual settling up of the postage-stamp department will always show a loss, both direct and indirect. That it draws people to the store who may buy some of the wares attractively displayed is a fallacy proved over and over again by actual facts. During the rush hours of an active business the interruption caused by the selling of a postage stamp is a loss which offsets the occasional sale of something else which nets a small profit. The pharmacist who declines to provide a directory for public use, sell a postage stamp, or give shelter in stormy weather, or who does not follow the example of

the Hebrews who, St. Paul says, "took joyfully the spoiling of their goods" * for the good of the cause, suffers in public estimation; yet it must be admitted that it is a difficult proposition in these days to take joyfully the spoiling of one's goods, and it cannot be denied that a pharmacist contributes largely to the betterment of life conditions by doing his share without counting the cost.

The movement, now so widespread, of lessening the burdens of life to one's fellows may be materially assisted by the practical work of enlisting the services of the pharmacist in aiding the physician in preventing disease, particularly in times of epidemics; witness the remarkable spread of contagious diseases during the last six months, which has been attributed by the people largely to the mild winter. The public have helped by observing quarantine regulations with as good grace as possible, but much can be done by the pharmacist if he keeps continually in mind little details connected with his business. It is difficult to uproot old habits and train assistants to be cleanly, and to educate them in our colleges in the important duties of dispensing prescriptions. Everything sent out from the drug store should be free from lurking germs, and containers, whether bottles, jars, pill-boxes, etc., when known to have come from infected houses, should be immediately destroyed, or thoroughly sterilized before being used again. This should be an invariable rule even when dispensing to a quarantined dwelling. Containers are frequently handled by messengers, and infection cannot be prevented; even the corks should be destroyed or effectively sterilized. The habit of pasting one label over another is always reprehensible, but it becomes particularly offensive when a bottle returned from an infected dwelling is sent out without being thoroughly cleansed, and old corks and labels destroyed.

There is reason to believe that dispensaries in hospitals, particularly those which give free services, neglect to use proper precautions. There are many antiseptic solutions and disinfectants which are cheap and can be used to advantage. Mothers should be taught that the spoons and other utensils used by the sick member of the family should be kept away from others who are well. The exhibitions which have been given from time to time in some of our larger cities on the subject of eradication of tuberculosis have been of value in

* Hebrews x, 34.

educating the public, and the pharmacist can do an important service to the community by cautioning patients and others how to prevent the spread of infection. The shortsighted or selfish druggist may silence his conscience by ignoring these principles and declaring, "It's none of my business and I do not care to bother about this subject!" The writer confidently believes that education and enlargement of view will put such men in the minority. If the members of the medical profession who wield a strong influence over the pharmacist will encourage co-operation, it would be of great assistance in preventing the unnecessary spread of disease.

Neurology

PSYCHONEUROSES IN THE MALE¹

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PSYCHONEUROSES is the latest term for various neurotic affections dependent to a great extent or entirely on mental rather than physical conditions, though there may be, and usually is, some slight physical disturbance as their basis. These affections are often very annoying; they are accompanied by symptoms that make the patients miserable. Above all, there are various emotional manifestations that unman male patients, who become dejected at the thought that they cannot control their feelings. Indeed, it is probable that the men thus affected suffer more,—in the sense of having to bear more discomfort,—than the majority of those in whom genuine and serious physical pathological conditions are at work. Physical suffering is often a stimulus, some of our real invalids (witness Robert Louis Stevenson) have been great and successful workers; mental suffering is nearly always an extinguisher of incentive and an inciter of gloomy feelings. Who ever heard of a neurasthenic doer of great things?

These affections, now called psychoneuroses, were in the older time mainly observed among women, and were called hysterical, because they were supposed to be in some way connected with the genital system of the patients, the word “hysteria” being derived from *hysteros*, the Greek word for uterus. While such affections are more markedly manifest during the menstrual periods, it has long been recognized that they have little relation with the genital

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system. They may develop absolutely without pathological change in the internal or external genitalia, and may appear before puberty, or long after the menopause. These disturbances, too, were not infrequently noted among men, especially among young men. Under such circumstances, it seems quite absurd to use the word hysterical for these conditions. Young, vigorous men, especially after an accident in which they sustained only slight injury, but in which they were badly frightened or very much shocked, may develop exaggerated symptoms that resemble those conditions seen in women to which the word hysteria has been applied. Such cases are more frequently seen in Europe than in this country, particularly among young soldiers during enforced military service in those European countries where every man must serve his time in the army.

The soldiers, as a rule, are between eighteen and twenty-two years of age, and are often away from home for the first time. Their training as soldiers is rather severe; they have to rise early in the morning, and are often obliged to be on duty for many hours; as a consequence they develop a highly irritable condition, which may be marked by neurotic explosions. Home-sickness, the nagging of petty officers, food to which they are unaccustomed, especially those who have come from good homes, the practical jokes of comrades, and the modified hazing that can apparently never be wholly suppressed where young men gather together, all contribute to produce a state from which, by some accident or shock, many of the young men are precipitated into a highly neurotic condition. There is little opportunity in this country to observe such symptoms, though I have known them to develop in youthful members of surveying parties who had just left college and were "roughing it" for the first time, and had to stand a good deal more of fatigue than they had anticipated. Their life in the open, however, usually preserves them from the worst forms of this affection, for soldiers in the European armies are often obliged to live in rather crowded quarters in gloomy barracks, under circumstances where recreation from sleep is not as effective as it might be.

It may be seen also among young men who are under training for athletics, either without proper direction or under circumstances which make the director willing to run a little risk in order to develop successful athletes that are needed for the teams. The

process known among athletes as "going stale" is really a neurotic manifestation combined with a distinctly psychic element,—a true psychoneurosis corresponding rather closely to what might well be called hysteria. Their physical condition is excellent, but they have continued their exercises so long that a nervous tension is distinctly noticeable, and a coming contest so excites them that they are unable to utilize all their energy, and are easily made to react exaggeratedly. They are easily startled, cannot always be depended upon to do the right thing when called upon, their senses lose some of their acuity, and, above all, their incentive, that is, their power to see a chance to do something requiring personal initiative, is diminished.

This is why a husky young athlete may be found in tears after the loss of a game, or because of a mistake that perhaps under the circumstances could not well have been avoided, though it can usually be attributed to staleness due to overtraining. Magazine stories of football and other contests in recent years have brought out this tendency rather markedly, and young women readers are prone to consider such manifestations the sign of a very tender heart and, perhaps, of sentimentality. They are a sign of sentimentality, but not at all of manliness, and they constitute real hysteria. The overwrought speeches that coaches are sometimes represented as making to groups of athletes when games must be won—or lost—are also a symptom of hysteria. If they are ever really made, the coach has gone stale too, and needs a physical director to take care of him. Men do their best work, not in the stress of such excitement, but in the quietude of nerve by which they keep themselves well in hand to perceive and seize opportunities.

Such manifestations are sometimes supposed to be of recent development, but they are as old as human nature. Some of the stories in Herodotus represent by anticipation these hysterical or, as they might better be called, psychoneurotic tendencies. Sentimentality in expressing itself nearly always shows this tendency to become hysterical. The emotionalism of the Eastern nations which so readily expresses itself in tears is a symptom of an overwrought state. Homer's Greek heroes weep upon occasion, and when they are hurt make no attempt to repress their feelings, but bawl out loudly, and there is generally a lack of that self-repression commonly displayed in the modern world, except among the neurotic.

In our modern day the most fruitful source of these psychoneuroses is undoubtedly found in the environment of a man who has been developing his muscular system either by actual hard work or by athletics, and is then confined to an office or to very narrow quarters, which give him little or no opportunity to utilize his muscular energy. Many a man who has worked hard in his youth at some outdoor occupation, and, through the opportunities for advancement afforded by American life, has risen to some executive position in a large corporation, must now do all his work in his office. Time is precious, and his salary is large, and, following the example of those around him, he takes a taxi or his own auto to his office every day during many months of the year when he is busy. This is only the beginning of a physically inactive day. He probably has his lunch brought to him from a restaurant in the same building as his office, speeds home by motor, dresses for dinner, takes a taxi to his club and a rubber at whist for recreation, or goes with his wife to the opera or to the theatre, or to one of the almost innumerable banquets that his official duties more or less compel him to attend. Finally, an iron constitution, which up to the age of forty-five has never given an indication of ill-health, refuses longer to conform to such a deadly routine for a man of good muscular build and development, and neurotic symptoms begin to show themselves.

Such a man is likely to become a sufferer from insomnia,—or at least what he calls such,—because, after an evening of excitement, he cannot sleep for several hours after going to bed. He may also suffer from constipation, but not until—after various warnings which he considered to be indigestion—he has considerably reduced his diet. Indigestion with discomfort after eating is particularly noticed. If this state continues, and he takes no exercise or, above all, does not get out into the air, after a time other organs will also suffer. His stomach will almost certainly interfere with his heart, and make him so conscious of its action that he will describe himself as suffering severely from palpitation. Muscles all over his body will rather easily become fatigued. If he stands much the arch of his foot begins to yield, and he experiences pain, referred not directly to the foot but to the leg and knee, which he regards as rheumatic. If, for some reason, stooping becomes a portion of his routine, he will develop pains in the lumbar region, always worse in rainy weather, therefore presumably due to rheu-

matism. Above all, he will have a sensation of tension and discomfort when his teeth are pressed together because of nervous contraction of the muscles of his jaw, or perhaps occasional movements in them; there may be a distinct tendency to develop slight ties.

If the man is young he will almost certainly have spells of self-pity, during which he will feel intensely miserable, or may even cry. He is certain that he has some serious disease, perhaps thinks his heart or kidneys seriously affected, and that the end cannot be far off. Under these circumstances appetite and sleep are still further disturbed, and what is called a nervous breakdown develops. His depression indeed now becomes so profound that friends may fear for his mental balance, and, even before his friends, he thinks it possible that he is going out of his mind. This is, of course, a picture of the worst type. Milder forms of the affection, with a certain amount of depression and hysterical self-pity, are quite common.

In order to convey a clear idea of these cases, a discussion of some of them in various walks of life that I have seen in recent years may be of service. I shall select men of different professions to illustrate the development and course of the affection.

Naturally I have noticed these symptoms oftener among those who had been athletes at college than among those who were hard workers in early life, because I have been so situated that college men have drifted toward me. The first case, however, to which I would call your attention is an exception to this rule, being that of a banker who, after working hard at manual labor and, a little later, as a book-keeper, realized the necessity of keeping in good condition, and had consequently resorted to various forms of athletic sports. He joined an athletic club, a boating club, a walking club, and at least one day and a half in every week was devoted to some one of these various exercises. Nearly every evening he did some hard gymnastic work or played a handball game, or something of the kind. His summer vacation was always spent in strenuous exercise—sometimes hunting, sometimes mountain climbing, sometimes boating or canoeing under difficult circumstances. He was a magnificent specimen of physical development, very proud of it, and kept himself in good condition.

Gradually as the years advanced his business made heavier demands upon his time, exercise became less attractive, sport less allur-

ing. Finally, as he could only take time for exercise at intervals, the feeling of fatigue following it became very marked; he was sore the next day; he found that he needed more sleep, and was less capable of attending to business, so he gradually cut out most of his strenuous muscular activity. For five years there was no noteworthy symptom. It is true that he now noticed that a cup of coffee taken after six o'clock would keep him awake, although, as a younger man, he had been accustomed to take a large cup of it as late as eleven o'clock at night after a day's strenuous exercise, and had gone to sleep without delay. To his surprise, even a cup of tea now made him wakeful. In other ways he became more irritable than formerly, was more difficult to get on with, became somewhat testy about mistakes, and friends did not find him as genial as before. The reactions of his nervous system became more marked. On the occasion of a slight fire in his home, he found that some of his old coolness and presence of mind cultivated by years of active sport was gone, and that he gave way to excitement.

One day, while riding on an elevated train, the man in front of him insisted on keeping a window open, though it was a rather damp day, and for half an hour the breeze blew on the side of his neck. The next morning he had a painful spasm of the muscles of the neck, involving particularly the sternocleidomastoid, but affecting also some of the muscles at the back. He had never experienced anything like this, and was consequently much disturbed. Under rubbing and mild counter-irritation this got better, but during the following winter several groups of muscles became affected. His knee-joints, particularly, began to annoy him, and on coming downstairs in the mornings they were apt to be painful or to ache. When he first got out of bed in the morning his feet were tender and somewhat sore on movement for a few minutes. After a time this wore off, but his feelings were so different from those which he had been accustomed to for years when he sprang out of bed feeling fine and fit that he became worried.

Then he began to regulate his diet. He had read of the uric acid diathesis, and the tendency of meat to cause an accumulation of uric acid in the system; accordingly he began to limit his consumption of meat, of which he had been a plentiful eater, and, above all, to avoid the red meats which had been his special favorites. Other articles of food were gradually cut down in amount, and as

he became more and more conscious of his eating he took less variety. He had been accustomed to eat whatever he liked, and to stop when he felt he had enough, but now, almost unconsciously, he began carefully to measure amounts, and to be rather glad when he got up from the table without having eaten much, confident that abstinence would be beneficial to him. He had not long been under this régime when he began to suffer from constipation. He had never been troubled with this before, and, as a matter of fact, had been quite unconscious of any necessity for noting the times and frequency of movements of the bowels, for he had simply depended on the calls of nature. Now if he did not have a call by a certain time in the day he worried over it. Soon his sleep was disturbed. This was partly due to the fact that he rarely went to bed until after twelve; and, as his last meal was eaten about seven, his stomach was then rather empty. Moreover, he awakened early in the morning, something that had never happened to him before, and then could not get to sleep again.

All this affected his spirits, but, instead of returning to his old habits of taking outdoor air and exercise, he became more inclined to stay in the house. As a fact, his lessened dietary did not supply as much energy as before. Besides, it was some years since he had indulged in exercise, and, after trying it for a few times in the old-fashioned way, and of course overdoing it because his muscles were not fit for it, he found he did not sleep well after it, and was very tired and sore the next day. After he fell asleep he had tossed and wakened several times, and had dreamt of the soreness of his muscles. This convinced him that, at his time of life, approaching fifty, it was too late to resort to exercise again, so he began to spend more time in bed.

Before long he was profoundly miserable, and the conviction that some serious illness impended, or that he was actually degenerating, intruded upon his business hours. He feared that he would be unable to continue his business. Then he noticed lapses in his memory, he was sure that he could not make decisions as before, losses that came in the natural course of business were attributed to his losing his grip, or at least he feared that he was, and his mind dwelt more and more upon himself until he was overwhelmed with a sense of inadequacy in his business achievements. He felt that he could not think clearly, that the effort required to do so was so

great that he would injure himself in making it. He watched himself so closely while making any business effort that this surveillance wasted more energy than the work necessitated.

In the meantime he had lost weight, was more and more unable to sleep, his muscles were more painful, and his knees bothered him more on coming downstairs. He was obliged to sign a large number of bonds, and this made his shoulder very sore,—producing really a form of writer's cramp,—and he was quite convinced that he had a constitutional disease. A vacation spent at Atlantic City benefited him for the moment, but he soon relapsed, and was about to give up hope. He confessed that when alone he sometimes cried over his condition, and pitied himself very much.

His muscular pains were entirely due to disuse or wrong use, and his knee-pains to beginning flat-foot and the fact that he was accustomed to stand much during the day at a desk specially constructed for him, because he had understood that standing had a tendency to relieve constipation. He was persuaded to go back gradually to his exercise, and take it regularly every day. His regulation of his diet, as he called it, was really an extreme limitation. He was induced to eat more plentifully, and the digestive symptoms at once lessened. Little medicine was needed for the constipation.

As soon as he got out more in the air he slept better. He was advised to join a golf club, and spend Saturday afternoon at least on the links. It was felt, however, that he needed daily exercise, so he was persuaded to walk from his office to his home every evening, a distance of some five miles, beginning with two miles, increasing to three, and then walking the full distance. Practically the one modification of his habits absolutely necessary was to take exercise in the open air; exercise in the gymnasium never did him much good. He now walks the full distance from his office to his home at least four days in the week, and he sometimes spends two afternoons a week at the golf links. All of the symptoms have disappeared. He has ceased to watch himself when at work, he finds that his memory has not failed, and that he is able to put a deal through as well as ever. Above all, he has lost the feeling of apprehension,—of something hanging over him, that something was about to happen,—which formerly made his life miserable. He does not now worry lest some engagement has escaped his memory, he drops business outside of business hours, and occupies his mind with other things. His case

might have been diagnosed as nervous exhaustion, and he might have been told, as many of these men are, that his business was too exacting, that he needed rest and change, while what he really needed was more outdoor exercise and diversion of mind.

The next case is that of a physician who had been on all of the teams at college, who played football, baseball, handball, and hockey on the ice, and who for six years of his college life had never passed a day without an hour or two of strenuous exercise. He had never known what it was to be ill. From this very active life he took up the study of medicine, and suddenly became most inactive. One of the professors took him into his laboratory in his first year, and he became so much interested in the work that he spent all his extra time there, his only exercise being his walk to and from the laboratory to his meals and classes. He lived only a block from the college in order to save time. Of real exercise he had practically none, for he stood quite still at his laboratory work many hours every day. For the first two years everything went well. During the strain of his third-year examinations he began to be sleepless, irritable, and to make changes in his diet. Instead of spending his vacation as usual in hospital and laboratory work, he rested for a time, but at the end of his fourth year nearly broke down. This was the result of intense application, lack of nutrition because of the conviction that he had been eating too much, consequent constipation, tendency to insomnia, and heightened nervous irritability caused by inanition, self-absorption of mind, the want of proper muscular exercise, and the strain of examinations.

After graduation he took up laboratory work as a teacher, gradually became more and more nervous, and developed further symptoms. Nervous indigestion was followed by palpitation, then by irregular heart action which made him feel that he had a serious cardiac affection. He worried a good deal over this, and, although a life insurance company insured him for \$5000, he felt certain that the company's doctor had made a mistake. He began to rest more than ever, lying down for an hour every afternoon, and spending nine or ten hours in bed every night. Instead of improving he felt worse. He got up feeling very tired and depressed, with a sense of some danger impending. It is surprising to find in these cases how common and prominent is this symptom.

After a time it became difficult for him to continue his work,

his heart palpitating on slight exertion, and he was obliged to rest a good deal of the time. He was so much disturbed that he expected soon to see serious signs of failure of heart compensation, and then he made his will. Fortunately, he was called out of town to see a relative and very dear friend who had pneumonia, and for nearly a week the physician had to think of somebody besides himself. Added to the excitement of a rather long railroad journey, he got considerable outdoor air and exercise while seeing patients in the neighborhood who insisted on having his advice, and this proved a stimulus to exertion. Just as soon as he became more active,—not being in a position to use a machine at every turn as he had been while in the city,—he began to feel better. When he returned at the end of a week, things did not look so serious as he had pictured them before, and a regular course of exercise soon restored him to himself. He found that he must walk several miles every day, and that between each two meals he must be out in the air for a time, or else nervous indigestion would disturb his heart action; this, however, steadied down at once when he began to take systematic exercise.

A very similar case developed at an earlier age in a clergyman. He had been the captain of the football team in his senior year, was shortstop on a baseball team, and rather active in track athletics, especially the indoor games of the winter. After his ordination he became curate in a city parish, where he was expected to be thoroughly dignified in his pursuits, and in consequence had no exercise. He gained rather rapidly in weight, and soon noticed an irritability of the nervous system which kept him from sleeping well. Constipation soon set in. He began to have muscular pains, more noticeable in rainy weather. After some years as curate, during which time he became stouter and more flabby, he became rector of a suburban parish, where he was obliged to straighten out some complications that had arisen during the previous incumbent's tenure. For a month and a half he was seldom outside of the house, for there were few sick calls, he did not know people very well, and the entangled business matters of the church demanded most of his time. Often, for two or three days in succession, he would not be outside of the house except for the morning service. At the end of six weeks he was in a highly neurotic condition,—sleeping miserably, not caring to eat, and with a conviction that there was something seriously wrong with him.

His tendency to constipation became an obsession, and he was sure that he was absorbing toxic substances from his intestines. He had read much of intestinal auto-intoxication, and he felt that he was a typical example of it. He used the so-called internal baths, injecting as much as a gallon of water—and, if his story is to be believed, at times even two gallons of water—several times a day into his intestines. His neurotic symptoms became still more marked until, if permitted to talk freely about himself, he would cry in self-pity. His low spirits kept him from getting out, and he confined himself more and more to the house. Finally, his depression became so marked that it was suggested he take a holiday. He did so, but soon returned, for he did not readily make friends, and the diversions at the Hot Springs, to which he went, were not such as he cared for.

His friends became alarmed about him, and at last a sea voyage was proposed. This was taken on a slow steamer to Naples, where he was to stay for one week and make, mainly on foot, certain excursions mapped out for him in the neighborhood; fortunately a congenial companion was found, and a daily programme of exercise on board the vessel was planned. He returned at the end of six weeks very much improved. Almost immediately, however, he began to slip back, but it was pointed out to him that he must get into the air more, and take regular exercise. He now walks at least five miles a day, rain or shine, and is in an almost normal condition. Above all, he realizes that his development of muscle in youth makes it absolutely incumbent upon him now to exercise those muscles, or their disuse will produce symptoms.

Whenever he goes without exercise for any prolonged period he has a very irregular heart action; sometimes he misses every third beat. Now and then this is accompanied by a most annoying consciousness of the heart action, especially of its intermittency. At night, with his ear on the pillow, he listens for the missed beats, and this prevents sleeping. As soon as he resumes regular exercise the heart becomes steady. Indeed, the heart action is almost absolutely an indication of the amount of muscular exercise he has recently taken. If the amount is small, every ninth or tenth beat will be missed. When the exercise is considerable, yet limited for him, a full minute will sometimes elapse before intermittency is noted. After three or four days on a hard walking tour, followed

by a good rest, his heart will run along without the slightest intermission, though counted for minutes at a time.

The next case that illustrates this tendency of the man of muscular development who has used his muscles much in early life to become distinctly neurotic if he changes to a sedentary occupation is that of a rather wealthy capitalist. As a boy and young man he had worked in mines. He fortunately hit upon an invention for hoisting purposes, the patent for which proved absolutely unassailable. It was installed in mines throughout the country, and he made money very rapidly. He built himself a handsome house in the suburbs, and proceeded to enjoy life. A limousine carried him every day from his house to his office, he took his lunch in the building where his office was situated, and thus it often happened that for days at a time his only outing was taken in the tonneau of his machine. This trip consumed about half an hour twice a day. His wife had no interest in opera, and, while they went to the theatre occasionally, it was comparatively seldom, and they had little social life. His evenings were usually passed in his library, smoking, reading the papers, and occasionally the magazines.

As a young man he had been healthy, had been noted for his muscular strength, had worked hard, and had a hearty appetite. His appetite continued to a great extent after he began to lead a sedentary life, and he put on considerable flesh. He was rather uneasy to find himself short of breath on several occasions when he had to walk up more than one flight of stairs. After a time he became irritable, despondent, and somewhat unpleasant with his family. He had absolutely no interest in sports, did not care for horses, scouted the idea of farming, and thought golf a pottering nuisance, only good for men who had no real interests in life to occupy them. After a time his sleep became disturbed, and he was anxious about it. He frequently said that his life had been happier when he was poor, and lamented that, now that he could enjoy himself in any way that he wished, there was no pleasure left in life. After a time, too, slight losses in business which he could very well afford, and that were quite inevitable,—as a rule, the commonplace chances of the business world that every one must set down to profit and loss,—began to “get” on his nerves. When a servant stole some of his wife’s jewelry he brooded over it for weeks and could scarcely be got to say anything while at home. When a

small enterprise in which he was engaged as a minor stockholder failed, he seemed to think that his business reputation had been ruined forever.

In the midst of this the panic of five years ago came along, and he had to stand some pretty severe losses in which many thousands of dollars were involved. There was absolutely no danger of his fortune being seriously affected, but he had a serious attack of depression during which he made statements as to his probably dying a poor man, or having to take up his former mechanical work for his living. His state of mind kept him still more indoors. He was sure that people were ready to point the finger of scorn at him, to prophesy his failure, and to rejoice over his losses. He kept in the house, had practically no amusements, no social life, nothing to occupy him but his own dark thoughts. There were tears in his eyes whenever he spoke of himself, and while he bemoaned his ill fortune he still more bewailed his lack of good health. At night he often could not sleep for hours, and he wakened early in the morning with the thought of his most recent loss on his mind, and could not get it off, nor could he go to sleep again. Some near relatives who got closely in touch with him were much disturbed over his emotional condition, and feared seriously that his mind might give way. He had never been known to be emotional, and his present exaggerated anxiety was a shock to them.

He found it difficult to set his mind seriously to work, he made mistakes in business details that had formerly been very easy for him, he felt the burden of his business, though it had before been a joy to him; above all, he found it extremely difficult to get on with his employees. He actually discharged two that had been of great value to him, but was extremely sorry for it afterward, and finally took one of them back.

This psychoneurotic condition was called neurasthenia consequent upon intestinal auto-intoxication and overwork. It was said to be complicated by the uric acid diathesis, because after exertion his muscles and joints now pained him considerably, and it was even called by one learned consultant lithiasis, whatever that may be supposed to mean. His diet had been tinkered with, mainly in the line of progressive limitation.

Coffee, of which he had been accustomed to take three or four cups a day, was now entirely eliminated. Red meats, which had

been his favorite article of diet ever since his early working days, had been cut out, and he was asked to live to a great extent on what he called slops,—cereals and puddings of various kinds, and green vegetables. Some attempt was made to secure for him diversion of mind, but without success, and the recommendation of exercise and air he had followed by taking a quiet walk three times around his own garden morning and evening, with a complacent feeling that he was carrying out the doctor's orders.

What he needed was exercise for his muscles and an abundance of fresh air. It took considerable persuasion, however, to make him realize this, because his muscles were by this time so unused to exercise that fatigue and aching readily developed, and there was so much soreness, especially in damp weather, that he was quite sure some constitutional change was at work. Gradually, however, the amount of his exercise was increased, and he was encouraged to find that his muscular soreness gradually disappeared. Once this had been secured, the increase of his exercise became easier, and he was even tempted to take up golf, until, like many another business man who at first thought it a foolish old man's game, he became quite enamored of it. When this had happened, and he was tempted to spend a couple of hours two or three afternoons a week on the golf links, the rest was comparatively plain sailing. He soon realized that what he had needed during his illness was air and exercise. He also recognized that the sole cause of his neurotic symptoms with the complicating mental depression had been the change in his habits from the time when, as a young man, he had done hard muscular work outside to the almost absolutely sedentary indoor occupation which he had been compelled to take up afterward.

I think that these cases illustrate very well the psychoneurotic conditions that develop in men who have had considerable exercise and muscular development in early life and subsequently have no use for their developed muscles. The muscles are much more than merely mechanical aids to the movement of bones. They are heat-making organs as well, and unless some of the heat that they manufacture is dissipated by work, it seems to be used up in various ways within the body to the disturbance of function. Just how heat regulation is affected we do not know exactly, but, when a man who has been accustomed to dissipate large amounts of heat in muscular work, and has developed the machine for the manufacture of it

to a high degree of efficiency, stops dissipating it, it must be a serious task for nature to dispose of it. It is this that proves such a drain on energy, makes men so tired that they wake up, as they say, more fatigued than when they went to bed. No wonder, then, that they lack initiative to so great an extent. This physiological succession of events must be kept in mind, and the habits of the organism during its developmental period must be reverted to in order to promote equilibrium. This is the most important point to remember in the treatment of these cases. Practically all the symptoms are secondary to this short-circuiting of energy within the body which so seriously disturbs function.

Of course, it must not be forgotten that in men over forty, particularly, who begin to develop neurotic symptoms and complain especially of tired feelings, disturbed sleep and appetite, the root of the symptoms may be a kidney degeneration or some condition of the heart or the liver. It is well understood, therefore, that the condition of these organs must be carefully investigated before there is any attempt to diagnose, much less to treat, the case. Many a so-called neurasthenia is really a kidney or liver case beginning its terminal stage. On the other hand, it must not be forgotten that the depression described as occurring in these cases may be a real beginning melancholia, but in that case there will usually be a history of some hereditary mental disease, or delusions that indicate the real mental condition. Neurotic affections have led to a much more serious prognosis in the minds of many people because of mistakes in diagnosis which attach the name neurasthenia to affections that are really much more serious. It is especially important not to mistake true melancholia for neurasthenic depression, but still more important not to interchange the names with the kindly purpose of not wishing to disturb the patient and his family, for there is always danger of attempted suicide in true melancholia and careful precautions must be taken. A number of the suicides among business and professional men are due either to this mistake in diagnosis or, unfortunately, to mistaken kindness, which is well meant, perhaps, but very risky in saving the feelings of the family and of the patient himself by substituting the indifferent word neurasthenia, or perhaps neurasthenia with depression, for the significant word melancholia which would have set every one on guard against suicidal tendencies.

A STUDY OF THREE THOUSAND CASES SEEN IN PRIVATE NEUROLOGIC PRACTICE

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THE records of 3062 cases taken from my private case book form the basis for this study. In a few cases a double diagnosis was made, and the total number of patients is probably not more than 2900. The diagnosis of non-nervous disease was recorded sixty times; among these were instances of diabetes (seven), arthritis, Bright's disease, leukæmia (three), anæmia (two), gastric cancer, dyspepsia, and ulcer, and seven cases of typhoid. This list might have been considerably extended, since a number of cases which I have seen which did not appear to come within the domain of neurology I have dismissed without making any record, and consequently they do not appear in the statistics which are presented. Some of these cases, however, presented nervous symptoms more or less striking. Indeed, one would not be far wrong in asserting that practically all diseases present nervous or mental phenomena more or less marked. I recall very well a case of aneurism which is recorded. This patient presented very marked symptoms of pain in the back, radiating about the chest and down one arm. Careful examination of the chest by my associate, Dr. Wright, revealed the presence of a large aortic aneurism. The cases of gallstones, gastric cancer, gastric dyspepsia, and gastric ulcer all presented some nervous symptoms. Typhoid fever is called, in the German language, "nervous fever"; and it is not surprising that my record should show seven cases of this disease. The seven cases of diabetes recorded all showed nervous symptoms.

Of the 3062 cases tabulated, 939, or nearly one-third of the whole number, were recorded as neuroses, psychoneuroses, and hysteria; 656, or a little more than one-fifth of the whole number, as cases of insanity; and 1467, or a little less than one-half, as func-

tional or organic diseases not classified as neuroses, psychoneuroses, or hysteria.

The records of a neurologist's private practice by no means indicate the relative frequency of various nervous diseases. The diseases which run a favorable course are not so apt to come into his hands. For instance, the records show only 21 cases of Sydenham's chorea. This disease runs a favorable course and is easily managed by the general practitioner. Of exophthalmic goitre only 12 cases are recorded, which is accounted for chiefly by the fact that these cases for some years past have been going to internists and surgeons rather than to neurologists. But, on the other hand, nervous diseases which are intractable reach the neurologist. A good example is epilepsy, of which there is a record of 182 cases. Of parietic dementia 132 cases are recorded.

INSANITY

In the table of insanity there are some duplications; and the same kind of cases are sometimes recorded under different heads. If these cases were all seen to-day there would be considerable revision of diagnosis, since they were seen during a period running back beyond the time when dementia præcox was recognized as an entity. Under such revision the 113 cases of dementia præcox would be considerably increased. For example, it is quite likely that a considerable number of the 158 cases recorded as melancholia and of the 48 cases recorded as paranoia, and perhaps some of the cases recorded as mania, would be now diagnosed as dementia præcox. The five cases diagnosed as pre-dementia præcox form an interesting group. Two of these cases were brothers. One, now 27 years of age, showed mental symptoms indicative of the early stage of dementia præcox five years ago. The symptoms cleared up and he has been at work since. The brother, a few years older, came under observation a few months ago with the same sort of symptoms. He is now under observation and treatment and shows considerable improvement.

After a hint from Dr. W. K. Walker, three cases were diagnosed "old maid's insanity," a title which is used by Clouston. The chief characteristic here is the possession of the idea by a woman that she is to be married, she prepares for her wedding, and has date

set, etc. This would seem a fine field for the members of the Freudian school.

PARETIC DEMENTIA

The fairly large number of 132 cases of paretic dementia is recorded. Probably this diagnosis would need less revision than any other of the so-called insanities. Although laboratory methods have been of great help, I do not recall many errors in the diagnosis of this disease.

HYSTERIA

The large number of 320 cases of hysteria is recorded. Those who would delimit this disease according to the teaching of Babinski would throw out the great majority of these cases. I, however, still adhere pretty closely to the teachings of the French school, although some of the French themselves have partly discarded it. Suggestibility is certainly a great mark of hysteria; but it is not the only mark. There is, for example, the indefinable hysterical character and temper. I do not believe it possible that analgesia and other sensory changes and contracted visual fields could often be simulated; they are strong indications of hysteria. The diagnosis of hysterical insanity is made 19 times. By this is meant any form of hysteria which presents mental symptoms in sufficient numbers and of character to constitute insanity. Many of these patients have shown a delirium which looks like alcoholic delirium, often with clouding of consciousness and great variability of symptoms and suggestibility. Diagnosis is often difficult, and errors have been made; but it is believed to be a useful diagnosis, as bearing upon the subject of prognosis.

PSYCHIC PAIN

Twenty-two cases diagnosed as psychic pain and five diagnosed as fixed pain form an interesting group and might perhaps be more appropriately classed with the hysterias. These are important cases and often puzzling in the way of diagnosis. Some of these patients have consulted many physicians; some of them have been subjected to various surgical operations. The diagnosis of psychic pain is to be made only with great caution; but when it is finally made it ought to be decisive and firmly adhered to, for a halting diagnosis

or provisional diagnosis cannot be of much help to the patient. Indeed, it is better to err occasionally than to make a diagnosis in a halting manner.

NEUROSES AND PSYCHONEUROSES

Probably the most interesting group of cases which the neurologist sees are the neuroses and psychoneuroses. Of these 619 are recorded; among them 314 cases of neurasthenia, 167 cases of psychasthenia, and 14 cases of asthenia are recorded. In a certain number of cases of nervous prostration there appears to be such general weakness of all vital functions that the term "asthenia" is most descriptive. In many cases of neurasthenia there is really a marked mental element, and revision of diagnosis would probably increase the number of cases called psychasthenia and subtract from the cases called neurasthenia.

Under the term "obsessions" 24 cases are recorded. In these cases obsessions were the chief symptoms. Probably most of these would be regarded as cases of psychasthenia and a few of them as definite psychasthenic insanity.

DAMAGE CASES

Sixty-five damage cases are recorded. A number of cases diagnosed "neurasthenia" and "hysteria" could be placed in this group which would easily number one hundred cases. These cases are chiefly those presenting symptoms pointing to neurasthenia and hysteria; and yet the majority of them have a peculiar complexion of their own; it is remarkable how much alike many of them are in symptomatology. From the standpoint of treatment, these cases have been most unsatisfactory. Not a single patient has returned for treatment after the settlement of the damage claims. Not a single out-and-out case of malingering has been recognized, although exaggeration is nearly always seen, and sometimes it is extreme.

MURDER CASES

An allied group of cases is the murder cases. Four only have been recorded. Other cases have either not been recorded or records

have not been preserved. I regret very much that a good, accessible record of all murder cases seen has not been kept, as they would probably number at least 15 and would afford material for a separate study. In all but one of the cases seen I believe the individuals to have been persons of mental inferiority and most of them insane. Whatever other mental phenomena were present, every person examined accused of murder failed to remember the actual shooting; and I believe every one of these murders was by shooting.* Over and over again this question was returned to in the examination; but in not a single instance was the story of the person under examination shaken by such questioning. I therefore accept the statement as true. The explanation, which seems to me plausible, is that the emotions at the moment of the killing are so intensely wrought up that consciousness is blurred or blanked because of this very height and intensity of emotion. I encountered one case of out-and-out malingering. This was a man who, after conviction of murder, suddenly became mute, refused food, bit at the keeper and attendants, and rushed at them to attack them, etc. The report was made to the effect that it was believed the man was malingering, and subsequently he was etherized; on coming out of the ether he spoke freely and acted as usual, so that no doubt was left in the mind of anyone, and the man was executed.

Of the 1467 cases of functional or organic diseases not classed under psychoneuroses, neuroses, hysteria, or insanity, attention is called to the following large groups: Seventy-eight cases of apoplexy are recorded—55 of hemorrhagic, 20 thrombotic, and only three of the embolic type.

The diagnosis of disseminated sclerosis was made 34 times, and this diagnosis has been made more frequently in the last few years. My records show that about one case in every one hundred which present themselves to the neurologist is one of disseminated sclerosis. Four cases are recorded as lateral or primary spastic paralysis of the Erb type; and one case of pseudosclerosis.

Paralysis agitans is recorded 32 times, therefore it occurs with about the same frequency as disseminated sclerosis.

One hundred and eleven cases of neuritis of various kinds are recorded, and only 27 cases of neuralgia. Doubtless some of the

* I recall one case where murder of a baby was committed by chloroforming.

cases recorded as neuritis would be classified by others as cases of neuralgia.

Another of the larger groups is poliomyelitis. A few of these are seen rather early, but not a single one in the actual acute stage of the disease.

Landry's paralysis, which for a time seemed a puzzling and mysterious disease, is now by most observers probably regarded as a form of poliomyelitis. Certainly it is closely allied to it. Twelve cases are recorded, and it is perhaps a little overdiagnosed because of my great interest in the disease. Three cases recovered, in one of which there was complete paralysis of both arms and legs and partial paralysis of the diaphragm. When the turn for the better took place the recovery was gradual, but finally became complete; so that in a clinical way it is still well to differentiate it from poliomyelitis; for with poliomyelitis of the ordinary type one would never see such complete recovery from such a very marked paralysis.

A group of cases which have been of particular interest and not a little satisfaction to me are those recorded as spondylose rhizomelique and sacro-iliac disease, eleven each. The latter diagnosis was made after Dr. Silver had called my attention to this condition. Perhaps the disease has been overdiagnosed; but certainly I have confidence in the reality of this condition, and the diagnosis is a very useful one. Spondylose rhizomelique also may have been overdiagnosed; but this diagnosis has also been useful and interesting. These patients have been helped a great deal by orthopædic measures.

Only one case of defective arch of foot is recorded. On a recent visit to the New York Neurological Institute I was informed that flat-foot was frequently diagnosed as explaining certain pains in the feet and legs; and our good friend, Dr. Silver, has here at home often emphasized the frequency and importance of flat-foot as a cause of certain nervous symptoms. I therefore feel that we should be on the outlook for flat-foot, since its recognition is important, because much can be done in the way of treatment.

TIC CONVULSIVE

Twenty-one cases of this are recorded. Some of these have been very persistent. The re-education method of treatment of Meigs-Fiendel has been of distinct help.

BRAIN TUMOR

Seventy-eight cases of brain tumor are recorded. I have seen enough other cases in my hospital practice to bring my observations up to probably one hundred. In about 15 of the brain tumor cases operations have been performed, with partial success in a few and very marked success in one, a case of cerebellar tumor.* The recorded cases of spinal cord tumor are only three. The record would indicate that brain tumor cases are 25 times as frequent as spinal cord tumors in Pittsburgh. The many recent operations for spinal cord tumors raise the question as to whether these cases are being overlooked.

BRAIN ABSCESS

Eighteen cases of brain abscess are recorded. This is a most difficult and disappointing group of cases. In only one instance did a clear recovery follow, and in this case it was only because there was courage to operate a second time. The second operation disclosed an abscess that the first operation did not reveal. Three or four cases were extremely disappointing, because the abscess was so nearly discovered; and one because, after the abscess was correctly localized and evacuated, the patient died.

TABES

The number of cases of tabes recorded is 75, so that it would appear that parietic dementia occurs almost twice as frequently as tabes.

SYPHILIS

Ninety-four cases of syphilis of the nervous system are recorded. Here again there are doubtless some errors of diagnosis; we may reasonably expect more accuracy, now that we have the modern laboratory methods at our disposal. The diagnosis of a certain number of these cases was afterward revised and relabelled "parietic

* Since this was written another successful case has occurred. A tumor was removed from the frontal region by Dr. Robert Miller, Jr., and the patient made an excellent recovery.

dementia." The laboratory has given a clean bill of health to a few patients who had supposed for years that they were suffering from syphilis, and thus was of inestimable benefit to them in the way of affording relief from mental suffering.

There are a considerable number of nervous diseases which even one practising a specialty sees only seldom. The records show of such cases the following: achondroplasia, 1; myotonia congenita, 1; angioneurotic œdema, 6; Jacksonian epilepsy, 3; double consciousness, 1; myasthenia gravis, 3; * tumor of spinal cord, 3; myoclonus multiplex, 1; myxœdema, 1; serratus magnus palsy, 1; syringomyelia, 2; tetany, 2; astasia-abasia, 1; Raynaud's disease, 3; hyperthyroidism, 1; Friedreich's ataxia, 1. No case of acromegaly is recorded; and no case of tumor of the hypophysis. (One case has been seen since this table was prepared.) Only one case of Korsakoff's disease is recorded, although several have been seen in hospital practice.

In a very interesting article Jelliffe and Brill (*Journal of Nervous and Mental Diseases*, vol. xxxviii, 1911, p. 391) analyze the cases seen in the Department of Neurology of the Vanderbilt Clinic for a period of ten years—1900–1909. The total number of cases examined during this period was 18,285, and represented between 4 and 5 per cent. of the entire number of cases of all kinds seen at the Clinic during this ten-year period.

This number of cases is, therefore, about six times the number reported by me in this paper. It will be interesting to compare the relative number of some of the cases seen in the Vanderbilt Clinic with those which I here report; and the following table is prepared to afford an easy and convenient method of comparison. In the first column the number of cases in the Vanderbilt Clinic is set down; and as the number of cases in the Vanderbilt Clinic is about six times the number reported by me, the second column represents the number of the Vanderbilt Clinic divided by six, while the third column shows the number of cases seen by me.

* I have since seen another case.

	Number of cases seen at Vander- bilt Clinic.	One-sixth number of Vanderbilt Clinic cases.	Dr. Diller's cases.
Idiots	144	24	9
Imbeciles	537	93	36
Dementia præcox	168	28	113
Paranoid states	55	9	3
Maniac-depressive	104	17	3
States of depression	154	26	158
Paretic dementia	237	39	132
Senile dementia	46	8	10
Neurasthenia	3500	584	314
Epilepsy	1666	277	177
Chorea	1589	265	21
Paralysis agitans	182	30	32
Speech defect	295	49	4
Neuralgia	967	161	12
Neuritis	677	113	110
Bell's palsy	370	62	18
Anterior poliomyelitis	389	65	35
Muscular atrophy	352	59	10
Amyotrophic lateral sclerosis	17	3	2
Multiple sclerosis	112	18	34
Tabes	385	64	75
Cerebrospinal syphilis	145	24	34
Meningo-myelitis	93	15	0
Syringomyelia	26	4	2
Friedreich's disease	9	2	1
Myxædema	3	1	1
Raynaud's disease	12	2	3
Muscular dystrophy	27	5	4
Cerebrospinal meningitis	18	3	14
Brain tumor	58	9	78
Exophthalmic goitre	116	19	12
Headaches	747	125	26
Alcoholism	366	61	33
Myasthenia gravis	4	1	3
Myotonia congenita	1	0	1
Acromegaly	1	0	0
Night terrors	25	4	4

No doubt, in many cases the diagnosis made in the Vanderbilt Clinic and that made by myself would differ. Our classification is somewhat different; and this would in itself account for the difference in the relative number of cases seen, and the kind of cases seen in a clinic would naturally differ somewhat from those seen in private neurological practice. In the Vanderbilt Clinic chorea

occurs twelve times as frequently as it does in my records. Jelliffe and Brill, however, state that chorea in the Vanderbilt Clinic occurs four times as frequently as at the Post-Graduate Dispensary in New York. Epilepsy is more than one-half again as frequent as it is in my records. Paralysis agitans, which certainly offers little room for diagnostic difference, occurs with almost the same relative frequency. The relative difference in the case of tabes is slight. It seems rather strange that parietic dementia should appear to occur in my record with three times the frequency that it does in the Vanderbilt Clinic; and that, on the other hand, Bell's palsy is four times as frequent in the Vanderbilt Clinic as in my records. In my records disseminated sclerosis is about twice as frequent as in the Vanderbilt Clinic. The fact that brain tumor is on my records nine times as frequently as on those of the Vanderbilt Clinic is probably to be explained by the fact that serious cases of this kind are the ones which are most likely to be brought to a practising neurologist. As before commented, the cases of exophthalmic goitre are few in number on my records—only 12; and they occur with only 50 per cent. more frequency in the Vanderbilt Clinic. There is not a great difference in the relative frequency of the occurrence of rare diseases, such as amyotrophic lateral sclerosis, syringomyelia, Friedreich's disease, muscular dystrophy, myasthenia gravis, myotonia congenita, and night terrors.

Surgery

REVIEW OF A YEAR'S FRACTURE WORK AT THE SURGICAL DISPENSARY OF THE UNIVERSITY HOSPITAL, FROM THE STANDPOINT OF THE GENERAL PRACTITIONER

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DURING the year ending December 31, 1912, there were treated in the Surgical Dispensary of the University Hospital, service of Dr. B. A. Thomas, 299 fractures, classified as follows:

Nasal bone	2	Ilium	2
Mandible	6	Femur	6
Rib	35	Patella	3
Scapula	3	Fibula	20
Clavicle	12	Tibia	10
Humerus	25	Fibula and tibia	13
Radius	54	Tarsus	6
Ulna	12	Metatarsus	3
Radius and ulna	38	Phalanx of toe	7
Carpus	6		—
Metacarpus	25	Total	299
Phalanx of finger	11		

These fractures were all ambulatory cases, those of the facial bones, chest, and upper extremity, and many of those of the lower extremity having been treated in the Dispensary from the outset, while the remainder of those of the lower extremity, many of which had been operated upon, had been treated first in the house, and therefore these cases fairly represent what the general practitioner may expect to meet with in office work.

Nasal Bone.—Fractures of the nasal bone require but little comment. They are nearly always compound, but are firmly united in two weeks without infection. There is usually a depression in the bridge of the nose, and often broadening, flattening, and lateral deviation of the nasal arch, reduction of which is best obtained by manipulation with the fingers externally and with a narrow steel rod internally. This reduction must be effected within the first week, and assurance against displacement by handling or blowing of the nose may be had by employing Roberts's tubular nasal splint. The adjoining nasal processes of the maxillæ, the septum, and, through it, the anterior cranial fossa may also be involved in the fracture. Douching of the anterior and posterior nares, and the insertion of bits of carbolized cotton into the former, are advisable, especially when there is coexistent coryza, in the presence of which influenza bacterin may be administered. In contusions of the nose in which no fracture can be definitely determined there may have been fracture of the cartilages which sprang back, leaving no displacement. The lateral cartilage may be dislocated from the lower margin of the nasal bone, producing a hollow in the dorsum of the nose near the junction of the middle and lower thirds. Hexamethylenamine may diminish the bacterial content of the nasal fossæ.

Mandible.—Of the six fractures of the mandible, three were unilateral, all on the right side, and involved the body in the vicinity of the molar teeth (Fig. 1). These were treated by splints, of which one was of moulded binder's board, the second of moulded plaster of Paris, while the third was a Levis metal splint, each being held in place by a Barton bandage secured by pins and adhesive plaster tapes. Oral sepsis was corrected in each case. The diagnosis is made by the history of a severe blow on the mandible, with inspection of the gum for a bleeding line, then manipulation for crepitus, and always a skiagram. Of the remaining three cases, two were bilateral, involving the body, while the third involved the symphysis and showed also an incomplete vertical fracture of the right ramus, just behind the coronoid. Two of these patients had very septic mouths, and were referred to the Dental Department. To one an interdental splint was applied. He developed an osteomyelitis on both sides, which healed after the removal of several sequestra. The other patient lost two upper teeth in the injury, and did not return

for treatment. The mandible may also be immobilized by soldering the lower to the upper teeth.

Rib.—Fractured rib was a very frequent injury in this series, occurring 35 times. But 12 patients were below 40, therefore it is a fracture of middle age. It is typically produced by falling against the sharp angle of a solid body, as a curb, step, or an anvil. Diagnosis is made by the form of injury, continuance of pain, especially on coughing or sneezing, and by a spot of localized tenderness along the course of a rib,—the most valuable and almost pathognomonic sign. Occasionally crepitus may be heard by the stethoscope, and, rarely, together with preternatural mobility it may be obtained on palpation. I believe that the reason for this is that most of these fractures are incomplete and subperiosteal. They were all treated by shaving the chest and strapping. Greatest relief will be obtained in the first strapping by applying a 6-inch band of adhesive plaster completely around the chest, thus securing the maximum of immobilization, as suggested to me by Dr. James A. Kelly. The later strappings may be made by applying 3-inch strips from above downward so as to include one-half the chest. A little phenacetin or codein may be required to alleviate pleural pain, especially in nervous patients. Firm union usually results in three weeks. Skiagram is rarely made in these cases.

Scapula.—Of the three cases of fracture of the scapula, two involved the body and extended into the axillary border at the neck (Fig. 2), while the third involved the neck. Two were due to falls upon the shoulder, and the third to a motor accident. Diagnosis was suggested by the location of the localized tenderness, and was confirmed by skiagrams. The case in which the neck was fractured was not diagnosed clinically, but by skiagram, because it was four months old. These fractures will rarely be seen by the general practitioner. The scapula is naturally splinted by dense fasciæ and muscles, but may be further immobilized against the ribs by suitably placed adhesive strips.

Clavicle.—The 12 cases of fractured clavicle—about 4 per cent. of the total number of fractures—do not support the prevalent idea of the frequency of this injury, although corresponding almost identically in percentage to that reported by Freeman in 1911 in 1428 fractures treated at the Homestake Mine in Lead, South Dakota.

FIG. 2.



Fracture of body of scapula

FIG. 1.



Fracture of body of mandible.

FIG. 4.



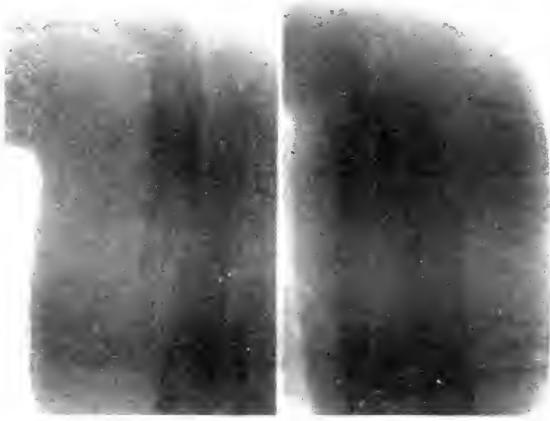
Fracture of shaft of humerus.

FIG. 3.



Complete fracture of clavicle in child aged
2 $\frac{1}{2}$ years.

FIG. 5.



Same as Fig. 4 after reduction.

FIG. 6.



Tear-fracture of greater tuberosity of humerus
in luxation of shoulder (unreduced).

FIG. 7.



Impacted fracture of anatomical neck of
humerus.

The majority (seven) occurred, as usual, in children, and were often greenstick. They involved the junction of the outer with the middle third (Fig. 3), except one which occurred at the upper half of the acromial end. These fractures are either very hard or very easy to diagnose. They are hard if greenstick or if involving the outer third, where preternatural mobility is prevented by the coracoclavicular ligaments. A spot of localized tenderness is of the utmost value here. By detecting a greenstick fracture and treating it the chance of its becoming complete will be minimized. A complete fracture may be diagnosed very often as the patient enters the room. In doubtful cases diagnosis by the transmission of respiratory sounds, in which palpable fremitus is lessened beyond the fracture (Erdman), may be of value. Of all fractures of the body I believe that of the clavicle causes me least concern—unless, of course, it is complicated by, for instance, rupture of the brachial plexus. This is because of the fact that it heals readily and rapidly, non-union is very rare, and, notwithstanding the deformity, almost perfect function is established. I have seen untreated cases in children whose mothers did not suspect anything wrong until they noticed the lump of callus, and they had apparently as good results as the fully-treated cases. As to conservative treatment, I have not been satisfied with the usual Velpeau or Sayre dressing. When we consider the great weight of the upper extremity upon the comparatively tiny clavicle, it seems that we should adopt much more heroic measures. Hence, Davis's method seems by far the most rational: "Apply a Desault bandage of flannel covering the chest and binding the arm to the side. A small hard roll of bandage is placed just above the outer end of the inner fragment and fastened with adhesive plaster. Over all is laid a plaster-of-Paris bandage while the patient is in a reclining position. He is then made to lie down absolutely flat on his back, the shoulders are to be pressed back, and the plaster moulded closely around the clavicle until it sets. This gypsum case not only supports the weight of the arm but tends to keep the shoulders back. The patient is allowed to walk around." In certain cases of transverse fractures near the middle, with great displacement, it may be advisable to insert a small fusiform, intramedullary bone splint.

Humerus.—Of the 25 fractures of the humerus, 13 involved the

upper end, three the shaft, and the remaining nine the lower end. Of these, two were due to muscular violence from pitching a baseball, one involving the surgical neck, and the other the shaft (Figs. 4 and 5). This bone is more frequently broken by muscular violence than any other bone in the body (Agnew). The remaining fractures were caused either by falls upon the elbow or by severe direct violence. Of the 13 fractures at the upper end, four complicated luxation of the shoulder-joint, and consisted of avulsion of the greater tuberosity by the external rotators,—a point emphasized by Ross and Stewart (Fig. 6). Skiagram should be taken routinely after reduction of this luxation. In one case a small chip was detached from the greater tuberosity by the kick of a boot, was suspected by localized tenderness, and was revealed by the skiagram. Of the remaining eight cases three involved the anatomical (two of which were impacted) (Fig. 7) and five the surgical neck. Diagnosis of impacted fracture of the anatomical neck is not easy, but should be suspected in a person past middle age (50) who has had a severe injury and complains of continued pain, tenderness, and disability in this region, and confirmed by skiagram. Of the five cases of fracture of the surgical neck, one was greenstick in a child, being incomplete internally, and another was complicated by luxation of the sternal end of the clavicle. One patient fell 30 feet out of a chestnut tree, another was crushed between a car and a stone pillar, another suffered muscular violence, as mentioned above, but the worst fracture, which was comminuted, occurred from a patient slipping on a banana peel and striking his deltoid region upon the edge of a step (Fig. 8). This patient showed at first three-quarter inch shortening, but, being an iron moulder, he was intelligent enough to wear faithfully an iron weight suspended from the elbow, so that the shortening disappeared within a few days. How, upon examination of the skiagram, he escaped laceration of the circumflex nerve is problematical. In treating these fractures the classical cuneiform pad in the axilla and well-padded shoulder-cap are employed, and this dressing is made much more snug by securing the shoulder-cap by broad strips of adhesive plaster applied over it and onto the trunk, and then a circular bandage. Treatment of fracture of the anatomical neck differs from that of the surgical neck in that in the anatomical neck the elbow is supported, while in the surgical it is

FIG. 8.



Fracture of neck of humerus.

FIG. 9.



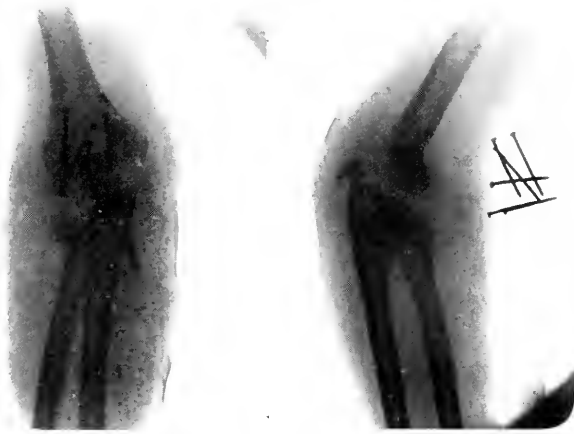
Supracondylar fracture of humerus.

FIG. 10.



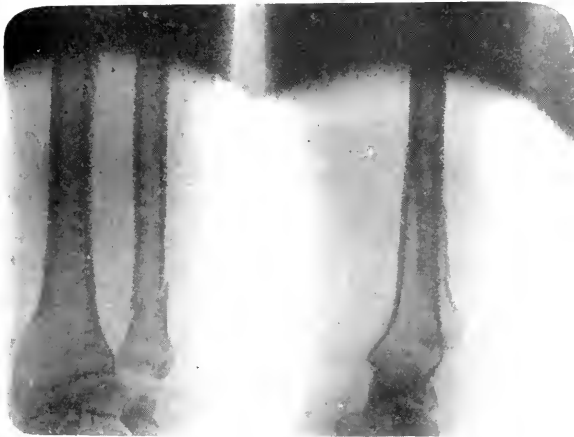
Impacted fracture of neck of radius.

FIG. 11.



Fracture of the neck of the radius.

FIG. 12.



Fracture of shaft of ulna near head.

left free for the force of gravity, aided, perhaps, by a weight, to overcome shortening. In many cases of these fractures it is well to dress the arm in abduction, because the resultant disability is most marked in a diminution of this power (Davis).

Of the three fractures of the shaft, one was comminuted, and was received by a fall from an elevator, 25 feet to the ground. It was at the middle, and was reduced by weight extension of two pounds, then four pounds. To correct the convex anterior deformity a posterior splint was applied to the arm, and over this on the one hand and over the convexity on the other there were run circular turns of a Martin rubber bandage. Another, which was produced by muscular violence, as mentioned above, showed a spiral oblique plane of fracture near junction of lower third with upper two-thirds, with slight forward displacement of lower fragment. The third patient was struck by a trolley car, and received a transverse comminuted fracture just below the middle of the shaft. The brachioradialis muscle was twitching near the elbow, showing irritation of the musculospiral nerve. These fractures were immobilized by the customary internal angular splint alone or with three short humeral splints. Non-union, so frequent here, was not noticed in this small series.

Of the nine fractures involving the lower end of the humerus, eight occurred in children. Two were supracondylar (Fig. 9) and one a disjunction of the entire lower epiphysis. Another showed an incomplete transverse fracture extending from the middle of the internal epicondyle through the middle of the floor of the olecranon and coronoid fossæ as far as the external condyle. There were three fractures of the external condyle, one associated with disjunction of the capitellum, and another—an ancient case—with chronic osteoarthritis of the elbow-joint, allowing extension of only 45 degrees from the right angle. There was one case of fracture of the external epicondyle, and in another disjunction of the internal epicondylar epiphysis. In all these cases the arm was placed in the hyperflexed Jones's position, if not at first, owing to great swelling, then gradually as the swelling subsided. Massage must not be begun too early in these cases—say until the third week—owing to the danger of mechanical inflammatory hyperreaction. Permanent ankylosis did not ensue in any of these cases, there being only a temporary stiff-

ness, which was soon relieved by judicious passive motion. Should true ankylosis result ultimately, arthroplasty will give excellent results.

Radius.—Of the 54 fractures of the radius alone, five involved the upper end, seven the shaft, and the remainder the lower end. Of the five fractures at the upper end, two involve the head, one of which was due to the usual cause of a fall upon the extended hand, while the other was a partial epiphysial separation (pulled elbow). The fracture of the head was definitely characterized by bulging of the capsule of the elbow-joint, with tenderness, just at the outer side of the olecranon. The neck of the radius was fractured three times, in each case from falling upon the elbow. Two were impacted. One showed, in addition, a small chip separated from the anterior lip of the head. One patient had no swelling, no ecchymosis, and no separation of the head from the shaft,—merely pain on the screw-driver movement and definite localized tenderness over the neck (Fig. 10). The third patient had, in addition, disjunction on the olecranon epiphysis and of the epiphysis for the capitellum (Fig. 11). There was another case of fracture of the neck of the radius, but, as it was complicated by splintering of the upper end of the ulna, it will be classified with fractures of both bones of forearm.

Of the nine fractures of the shaft, three were near the middle, one being above the insertion of the pronator teres, calling for the position of full supination. One was greenstick. The remaining six involved the lower third and four were greenstick. These were just too high to be classified with Colles's fracture.

Of true Colles's fracture there were 27 cases. By true Colles's fracture we mean a fracture within $1\frac{1}{2}$ inches of, but not involving, the wrist-joint, produced by fall upon the hyperextended hand, and thus resulting from the classical cross-breaking strain. Falls upon the hyperflexed hand do *not* produce Colles's fracture, for the mechanism is different, and the plane of fracture usually the reverse of that of Colles's. To these we might add 13 cases of Velpeau's fracture, which is Colles's fracture with, in addition, separation of the styloid of the ulna, but this variety we prefer to classify with fractures of both bones of the forearm. But rarely do we see the classical "silver-fork deformity"—the pet of the text-

book and lecture-room. Just as rare is the sign crepitus. We prefer to teach that Colles's fracture is one fickle in signs; that it may readily be overlooked, and as readily treated as sprained—or drug-store—wrist. Every diagnosis of sprained wrist should positively exclude, first and foremost, Colles's fracture. The most constantly suggestive sign (in addition to the character of the fall) is that of definitely localized tenderness just above the lower end of the radius, and best elicited by pressing on the ridge on the dorsum of the radius that separates the groove for the tendon of the extensor pollicis longus externally from that for the tendons of the extensor digitorum communis internally. Now if the tenderness be not definitely localized here, but diffused over the wrist-joint, I would be more inclined to diagnose sprain-fracture of the wrist. I have seen students make the apparently inexcusable blunder of diagnosing acute tenosynovitis of the extensor tendons of the thumb as Colles's fracture. Probably because there was no silver-fork deformity! As the second valuable sign I place ascent of the tip of the styloid of the radius. This is determined by placing the tip of the thumb at the base of the snuffbox and the tip of the index upon the styloid of the ulna, testing the uninjured radius first. Then I look for dorsal displacement of the distal fragment; for unnatural inclination of the hand toward the radial side; for undue prominence of the styloid of the ulna, and—but not until after a few days—for the appearance of ecchymosis. Colles's fracture is one that—contrary to the prevalent opinion—does not reveal itself upon superficial clinical examination. As to the advisability of a skiagram before reduction, I believe that nearly all these cases can be diagnosed clinically, and that no time should be lost in accomplishing reduction. The principle of reduction is simply hyperextension followed by hyperflexion, with pull toward the ulnar side. The former releases the usually impacted fragment, the latter draws it back into place. Nitrous oxide may be used if the patient is not a baby or an arteriosclerotic. Now let a skiagram be taken to see if reduction is complete and to see if there is any complication, as fracture of the styloid of the ulna, which may usually be suspected by localized tenderness over this process. The criterion of reduction is the relation of the carpal articular surface of the radius to the axis of that bone. If it is at right-angle, reduction is complete, whereas if it

face at all dorsally, reduction must again be attempted. For if this articular surface face dorsally, the function of the radiocarpal joint will be interfered with and a crippled hand result. It is astonishing how many Colles's fractures are insufficiently reduced. Once reduced the deformity does not reappear spontaneously, but a splint is necessary to protect the fracture from trauma. A Bond splint, padded so as to fill in the concavity of the radial shaft, is all that is required. The old cuneiform pads on the fragments, as well as the sidepieces on the splints, I have dispensed with as being superfluous. I consider it bad practice to bind the splint to the forearm with adhesive straps in this or in any other fracture. It is a thing that looks well but does not always behave well, and is unnecessarily annoying to the patient. A fairly firm muslin (and not gauze) bandage suffices. The fingers should be left free for the patient to move, and massage with light strokings should be begun the next day, for the extensor tendons playing over the dorsum of the radius must have no chance to become immobilized by adhesions or by callus. I am aware that some do not begin massage until the second or third week, but my masseuse has told me that my cases leave the board with the minimum degree of stiffness of the hand, and nowadays we aim to get our fracture patients back to work with the maximum of function in the shortest possible time. Neurotic patients will cling to massage and complain of pain beyond the customary time. Passive motion of the wrist-joint should be begun in the second week. A plaster-of-Paris case slit at the sides makes a good splint after the swelling has subsided. In old, unreduced cases osteoclasia by means of an ordinary monkey-wrench gives good results. I have dwelt at some length upon Colles's fracture because it is the one the practitioner most often meets with.

The alternative of Colles's fracture up to adult life is disjunction of the lower epiphysis of the radius, of which we had five cases. These are usually readily reduced, but with muffled crepitus instead of crunching, and are diagnosed when, after reduction of the deformity, a skiagram reveals no fracture. I have imagined the epiphysal line to be a little rougher-looking after disjunction, but of this I am not certain. One of these cases was complicated by fracture of the styloid process of the ulna, and another by tear-fracture of the tip of the radial styloid.

Other cases of fracture at the lower end of the radius include two through the base of the styloid process; two in which the tip of the radial styloid was chipped off; one in which the ulnar third of the articular area was separated; one of Barton's fracture, in which there was chipping off of posterior articular surface of radius; and one of tear fracture of the radius (wrist) in which a small shell was avulsed from the dorsum of its lower end.

A word about "chauffeur's fracture" of the radius. There are two mechanisms that may produce this injury when the crank "backfires." One is by indirect violence, in which the reversing crank carries the clinging hand back into hyperextension. This is less frequent, constituting but two of our seven cases. The other is by direct impact of the handle of the crank upon the bone. Of these seven cases, four involved the shaft below the middle, and the fifth cut off the radial styloid at its base. These were from direct violence. Of the two cases produced by indirect violence, one was a disjunction of the lower epiphysis, while the other was a Velpeau fracture. For the sake of completeness we may mention here a case in which, from indirect violence while cranking, there was fracture of the upper third of the ulna, associated with luxation forward of the head of the radius.

Ulna.—There were 12 cases of fracture of the ulna, five of which involved the upper end, six the shaft, and the remaining one the lower end. Of the five fractures at the upper end, one was a tear-fracture of the upper epiphysis—a rare injury—somewhat similar to the case I reported several years ago in the *Annals of Surgery*. There was also an old (14 years) unreduced anterior luxation of the head of the radius in a patient who had fallen upon the elbow, chipping off a portion of the olecranon. There were two cases of fracture of the olecranon process, in both of which the plane of fracture entered the greater sigmoid cavity. Since there was but slight separation the position of complete extension was not insisted upon, for so long as the fragments are held in contact by untorn triceps tendon and periosteum and are not separated by approximation of the forearm to right-angle there is no need of maintaining complete extension, as the fragments do not have to be apposed by position as they do in cases of marked separation. There were two cases which should be mentioned here, but which were classified above,

since both were accompanied by fracture of the neck of the radius. One was disjunction of the epiphysis for the olecranon tip as well as of the epiphysis for the capitellum (Fig. 11). The other was fracture of the olecranon as well as of the coronoid process. Another case was a curious greenstick fracture of the ulna one-quarter inch below the greater sigmoid cavity. It was produced by a fall upon the hand, and must be the alternate of fractures of the neck of the radius produced by this mechanism.

Of the six cases in which the shaft was fractured, five occurred at various levels in the middle third, one of which was greenstick. The highest of these involved the junction of the upper with the middle third, and, as is not infrequent in fracture at this site, the head of the radius was dislocated forward and outward from continuation of the vulnerating force. The frequency of this combined lesion as an entity has recently been emphasized by Ashhurst. Given, then, a fracture of the shaft of the ulna in the upper third, the practitioner should immediately suspect luxation of the head of the radius, and *vice versa*. Ashhurst says: "Anterior luxation of the head of the radius alone is considered by most writers a much rarer injury than that with fracture of the ulna." To secure favorable union of the ulna it is essential first to reduce the luxated radial head, if not by manipulation, then by operation of arthrotomy and capsulorrhaphy, or, in old, obstinate cases, excision of the radial head. The lowest fracture of the shaft was one inch above the styloid process of the ulna (Fig. 12). It was in fractures at this site that I suggested some years ago, in the *Journal of the American Medical Association*, the employment of a reversed Bond splint with a view to securing hyperabduction of the hand, thus drawing the lower fragment away from the interosseous space. I recently saw such a case, in which the upper end of the lower fragment could be clearly felt to be drawn away from the interosseous space by drawing the hand to the radial side.

The fracture at the lower end was an old one, involving the head and styloid process of the ulna, with angulation and overgrowth of bone.

Radius and Ulna.—There were 38 cases of fracture of both bones of the forearm, of which two involved the upper extremities and, as mentioned above, in both the neck of the radius was frac-

tured, while in one, in addition, there was disjunction of the epiphysis for the olecranon and of that for the capitellum (Fig. 11), and in the other fracture of the olecranon and coronoid processes. Twenty-three involved the shafts, of which 13 occurred at some level in the middle thirds, and of these six were greenstick. One of the fractures at this site was plated. Ten occurred in the lower third, all within $1\frac{1}{2}$ inches of the wrist-joint, and of these three were greenstick. There were 13 cases of Velpeau's fracture,—that is, tear-fracture of the tip of the ulnar styloid as a complication of Colles's fracture of the radius. In treating these cases of fracture of both bones of the forearm we are concerned not so much in securing a perfect anatomical as a *functional* result. That is, while the skiagram may show the fragments to be in anything but a desirable relation to each other, yet with proper care and attention function will usually be almost perfectly restored. In a recent article upon this subject Ashhurst aims "to secure firm bony union, with no appreciable shortening, and with preservation of the normal axis of the limb. For the first and second results it is necessary for the fragments to be in contact 'end-on,' and not only by lateral contact; and for the lateral displacement not to exceed two-thirds of the diameter of the bone." Furthermore, with Ashhurst we prefer to dress fractures of the shafts of both bones in the position of full supination instead of in that of mid-pronation, chiefly to obviate sagging of the fragments by gravity, with consequent angular deformity of both bones toward the ulnar side. The dressing is inspected the next day; massage begun at the end of the first week and continued thrice weekly; and passive motion of wrist- and elbow-joints instituted at the beginning of the third week.

Carpus.—There were six fractures of the carpal bones, of which one involved the cuneiform, one the unciform, and the remaining four the scaphoid. A small sliver was chipped off from the dorsum of the cuneiform by direct violence. This fracture recalls the emphasis recently laid by Ross and Stewart upon tear-fracture of the wrist as superseding the old and vague "sprained" wrist, or "drug-store" wrist. In every case of injury to the wrist, whether sprain or contusion, a good skiagram should be taken from the anteroposterior as well as from the lateral aspect, for in this way many fractures, be they ever so slight, will be graphically revealed

that might clinically be overlooked, and it must be borne in mind that an apparently negative skiagram does not refute the diagnosis of sprain-fracture, for the spicule of bone avulsed by the ligament upon which hypertension is put in sprain may be too minute to intercept the rays. These cases, therefore, should be treated as though a gross fracture were present. The four fractures of the carpal scaphoid occurred on the right side, and in two the distal fragment was displaced, while in another the semilunar bone was coincidentally luxated ventrally (Fig. 13). The cause of this injury was a fall upon the hyperextended hand. As is not unusual in these cases, two of the patients made tardy application for treatment, one seven months and the other 13 months after the injury, one having been treated for a "bad sprain" (the old, old story), while the other had received no treatment. All of these cases were diagnosed mainly by the sign of intense localized tenderness in the snuffbox when the hand is adducted well over toward the ulnar side, and in the two cases in which there was displacement the distal fragment was also felt in the tabatière. Other clues of value are the history of a fall upon the extended hand, limitation of motion, and in early cases puffiness about the sheaths of the extensor tendons of the thumb, and in late cases soreness, tenderness, and disability. A skiagram may or may not confirm the clinical diagnosis, according as to whether a good view of the scaphoid at right angles to its axis has been obtained. In this and in any other fracture I am inclined, in making my final diagnosis, to give more weight to important clinical symptoms and signs than to an apparently negative skiagram. In an article dealing with fracture of the carpal scaphoid Codman and Chase give the following directions for the best results with the X-rays: "A practical way to obtain a good picture of the scaphoid is to place the two wrists in adduction and to place the tube in a position over the midline between the two hands, as far forward as the level of the knuckles." By taking both wrists the error of mistaking a bipartite scaphoid for fracture will be avoided. Fracture of the scaphoid is *not* to be treated by massage and passive motion. We are dealing with a fracture of a bone within a joint, and therefore bathed by synovial fluid. This fluid notoriously retards, if not prevents, bony union. Then, too, the scaphoid itself is but feebly capable of osteogenesis. Massage

FIG. 13.



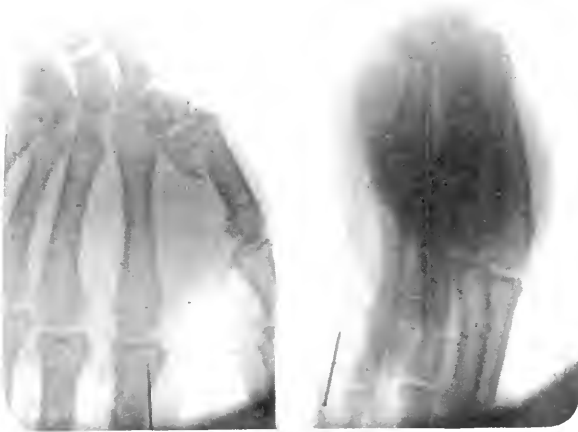
Fracture of scaphoid, with luxation of the semilunar bone.

FIG. 14.



Oblique fracture of 2nd and 3rd metacarpals.

FIG. 15.



Bennett's fracture, with dorsal displacement of distal fragment.

FIG. 16.



Fracture of patella from direct violence; wired.

FIG. 17.



Same as Fig. 16. (Lateral view.)

and motion only increase the amount of synovial fluid, thus adding fuel to the fire. To obtain union apply a splint immediately after the injury, and immobilize for four weeks. If at the end of this time there is still no union, or if the case has been untreated, or treated by massage and motion with resultant non-union, excise the proximal fragment of the scaphoid through a half-inch incision between the extensor digitorum communis and extensor carpi radialis brevis tendons. One week after operation institute active motion of fingers and then passive motion of wrist-joint. Avoid the legacy of chronic carpalitis by reasonably early operation. The case of fracture of the scaphoid with coincident luxation of the semilunar was clearly recognizable clinically, and the skiagram added but little to the picture conceived of the clinical findings (Fig. 14). This patient injured his right wrist seven months previously in a street accident, the mechanism of which was unknown to him. He was treated for two weeks at another hospital for a "bad sprain of wrist" (the same old story again), and a skiagram taken there was declared negative. Since then the wrist has been crippled, and he has pain in the wrist-joint on the slightest movement. Flexion and extension of the wrist were very limited. In fact, the hand was of but little use to him. Tenderness in the snuffbox and a projection in front of the wrist just below the lower end of the radius were pathognomonic of just two lesions,—the former of fracture of scaphoid, and the latter of anterior luxation of semilunar. There was also a shortening of the carpus, as shown by measurement from base of first metacarpal to radius. Skiagram showed, in addition to the fractured scaphoid, the semilunar to be driven forth ventrally. Its half-moon shape was beautifully clear. Owing to the long lapse of time (seven months) since the injury, but one method of treatment was indicated,—namely, removal of both fragments of the scaphoid and of the luxated semilunar. Had the case been seen earlier—say within two months after injury—reduction might have been possible by hyperextension followed by hyperflexion over the thumbs of an assistant held firmly in the flexure of the wrist on the semilunar,¹ but the scaphoid-resection

¹ The idea seems prevalent that luxation of the semilunar cannot be reduced without open operation. Since writing this paper I reduced such a luxation under gas anæsthesia, and shall report this in *Annals of Surgery* for the current year.

would probably have been necessary even then. The case of fracture of the unciform showed chipping off of the lower posteroexternal corner, which lies in close relation with the base of the third metacarpal, the two bones sharing the direct violence received in a fall downstairs.

Metacarpus.—Of the 25 fractures of the metacarpus, the first metacarpal was involved four times; the second metacarpal eight times; the second and third metacarpals (Fig. 14) together twice, in one of which there was coincident fracture of the proximal phalanx of the index-finger; the second metacarpal alone twice, in one of which there was coincident fracture of the adjacent unciform; the fourth metacarpal three times; and the fifth metacarpal three times, while in the three remaining cases, which were not seen by the author, the bone involved was not specified. The proximal and distal halves were involved about an equal number of times. The cause was either a fist-fight (one boy breaking his fifth metacarpal by hitting his uncle) or direct violence. Of the four fractures of the first metacarpal, two were instances of Bennett's fracture with dorsal displacement of distal fragment, in both of which the corners of the proximal end were separated and the carpo-metacarpal joint entered (Fig. 15). The best position in which to dress fractures of the first metacarpal is extreme abduction, and this is maintained by Golthwaite's tin splint in the first interosseous space, or by a gypsum case. Fracture of the metacarpal is readily overlooked. It should be suspected particularly in a man who has been fighting and who complains of persistent pain in the hand, and in whom there is definitely localized tenderness somewhere in the metacarpus. Like fractures of the rib, of the upper and lower ends of the radius, of the carpus, and of greenstick fractures, fracture here as well is best diagnosed clinically by one spot of intense tenderness. Rotation of the corresponding finger on its own axis and jarring it upward into the metacarpus may elicit pain at the site of fracture. There may be shortening of the corresponding knuckle. Often swelling of the dorsum of the hand obscures the diagnosis of the particular bone involved, but of itself is very suggestive of a fracture of the metacarpus. Lateral displacement is unusual unless the line of fracture be very oblique, and of the anteroposterior displacements, that into the palm is apt to cause pain in subsequent use of the

hand, the angulation acting like a foreign body in traumatizing the palmar nerves when the hand grasps some object. Dorsal displacement is insignificant. Treatment was by a straight splint with much padding in the palm and, when indicated, with extension of the corresponding finger by adhesive strips applied over the side of the finger and running over the lower edge of the board, with counter-extension by a strip encircling the hand obliquely between the web of the thumb and the ulnar corner of the upper edge of the splint. Early massage materially aids subsidence of the swelling.

Phalanges of Hand.—There were 11 cases of fracture of the phalanges of the hand, several of which were "baseball" fractures, and one was coincident with fracture of the second and third metacarpals. No difficulty should be encountered in diagnosing these fractures, although they, too, may be overlooked. It is never well to judge too hastily of the apparently superficial character of any injury. Even in these fractures a skiagram should be taken, as unsuspected fractures of adjacent bones may be found, as in my case where the proximal phalanx of the index as well as the distal halves of the second and third metacarpals were involved. After reduction by pulling on the finger a wooden tongue depressor makes a good, handy splint, and extension may be maintained by adhesive strips running along the side of the finger and over the lower end of the splint. After subsidence of the swelling in well-reduced simple fractures I believe sodium silicate is the ideal dressing here, as well as in fractures of the phalanges of the toe. An ordinary spica gauze finger-bandage is applied, and liquid glass painted over the successive layers. In a few hours, when dry, it forms a light, rigid dressing that is comfortable and readily removed by dissolving in hot water.

Fracture of Ilium.—There were two fractures of the ilium, both involving the anterior superior spine. One was an epiphyseal disjunction in a lad, aged 16, who, while running on a track, felt a "snap" in upper part of left thigh, but finished race (five yards). Pain was worse on flexing thigh. By manipulation of the epiphysis muffled crepitus was elicited. There was localized tenderness. This injury was doubtless due to muscular violence through the sartorius.² The more frequent injury from this mechanism is tearing-

² This case is pictured in *Annals of Surgery*, Feb., 1913.

off of the anterior inferior spine through contraction of the straight head of the rectus femoris. The other patient was a man, aged 40, whose left anterior superior spine was fractured by direct violence. As might be expected, he had pain along the external cutaneous nerve, which emerges from the pelvis close to the spine. Skiagram must be made routinely in any case of contusion of the pelvis, lest a fracture be overlooked. In young women the stay in bed should be prolonged after fracture of pelvis, in order to obviate complications in pregnancy.

Fracture of Femur.—There were six cases of fracture of the femur, all in males, most of whom were young, the ages ranging 10, 16, 17, 20, 28, and 62. This last case was due to a fall upon the pavement, and skiagram revealed an incomplete fracture of the neck of the femur. The best dressing here is weight-extension, not only in the axis of the limb but in that of the femoral neck as well (lateral traction). For children it is best to fix the limb in wide abduction, as suggested by Whitman. Three involved the middle of the shaft, and were plated with good results. Incompatible with a good result in fracture at this site is sagging of the ends of the fragments into the bed from gravity and overriding of the fragments. The former may be counterbalanced by dressing the limb upon a double inclined plane, and the latter by screw extension by one of the various methods. There was one supracondylar fracture the line of which was three inches above the knee-joint. It was treated by Buck's extension. If difficulty be encountered in reducing these supracondylar fractures, bear in mind Malgaigne's method: "Flex thigh to nearly a right-angle with pelvis, and then, flexing leg, with the forearm in the popliteal space, make extension, gradually restoring the limb to the straight position." The fifth case was a fracture of the adductor tubercle from direct violence. Skiagram showed clearly tendon of adductor magnus inserting into separated fragment.

Fracture of Patella.—There were three cases of fracture of patella, all due to direct violence—in two cases falls from a height, and in the third impact of a barrel of beer. These fractures (direct violence) are apt to be stellate and to show little or no separation, owing to non-ripping of the lateral expansions of the quadriceps

tendon. In one patient there was a compression-fracture at the apex of the patella. In one case the patella was wired (Figs. 16 and 17).

Fracture of Fibula.—The fibula alone was fractured in 20 cases, in one of which the upper end was involved, in two the shaft, while the remaining 17 involved the lower end. From the upper extremity a shell was separated from the styloid process by the patient falling four feet down an embankment, his left leg curling under. This was a true sprain-fracture (*arrachement* or tear-fracture). The two fractures of the shaft occurred at the junction of the lower with the upper two-thirds, and both from direct violence. These fractures are frequently overlooked, because disability is slight. Diagnosis is based upon careful palpation of the shaft from head to malleolus, when a spot of localized tenderness will be revealed which coincides with the site of pain elicited by pressing the fragments of the fibula toward the tibia, well above and below, respectively, the spot of tenderness. Skiagram usually shows but slight displacement. Treatment consists in application of a light, supporting sodium silicate dressing, which should be worn four weeks.

Fractures about Malleoli.—There were 28 fractures, involving one or both malleoli, which were produced by eversion, inversion, or by direct violence, the results of which varied within such narrow limits, according to the direction and extent of the force, that it is inexpedient and unprofitable to consider them separately. Thus, there were seven fractures of the lower end of the fibula alone due to eversion, in two of which the plane was oblique through the lower fifth, while in the remaining five the external malleolus was fractured at its base. These, because produced by eversion or abduction, are to be classified as true Pott's fractures. On the other hand, there were three fractures through the external malleolus due to inversion and two due to direct violence. The tibial malleolus alone was involved in six cases—in four from inversion and in two from direct violence. Both malleoli were involved in 10 cases, all from eversion, which was indirect in eight cases and direct in two. In all, the fibula was involved at some site in its lower fifth, and the tibial malleolus at some level between its base and tip (Fig. 18).

Thus, owing to variations in extent of the anatomical lesion, the term "Pott's fracture" is no more of a diagnosis than "Colles's fracture." These terms localize a fracture to the ankle and wrist,

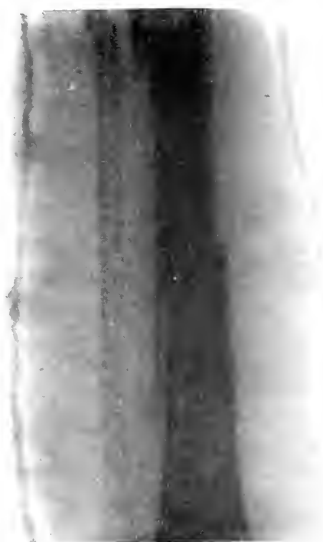
respectively, and indicate the mechanism, but that is all. Successfully to treat any fracture—and particularly those about the ankle—it is essential to know accurately the extent of the lesion as well as the position of the fragments, and skiagram should always be made if available. I believe it is safe to say that in many cases of fracture about the ankle the clinical diagnosis cannot be pushed beyond the point of a strong suspicion, and that the missing link must be supplied by skiagram. Whether there is a tear-fracture of a malleolar tip or extensive fracture with marked subluxation of the foot, as in Dupuytren's fracture, the same treatment is indicated—immobilization. The tear-fracture is apt to be dismissed as a "sprained ankle," and a painful or weakened foot result from superficial treatment. Often the avulsed shell of bone may be felt below the malleolus. In extreme cases, in which, owing to disruption of the intermalleolar mortise, there is extreme deformity from subluxation of the foot, it is best immediately to section the tendo achillis, when reduction will be not only readily obtained but readily maintained, and then the leg may be placed in a fracture-box or dressed with Dupuytren's long internal splint. After subsidence of the swelling and healing of contusions of soft parts, which requires about ten days, a gypsum case may be applied, taking pains to keep the foot at right-angle to the leg, lest pes equinus result from contraction of the calf muscles where the tendo achillis has not been divided, and to maintain the foot in a neutral position with respect to the malleolar mortise, it being neither overeverted nor overinverted, lest pressure of the astragalus against one of the malleoli permanently widen the mortise. Treatment of lesser injuries to the ankle varies, according to degree of severity, from immediate mobilization with use of hot compresses and massage, to the application of Gibney's strapping, or a sodium silicate dressing, or a gypsum case, provided there be no swelling. I think the common practice of applying a gypsum case and "letting it go at that" is entirely erroneous. I treat fractures about the ankle-joint with the same care as though dealing with fractures about the wrist-joint. I want to obviate ankylosis from tendosynovial or joint adhesions, and therefore remove the plaster case three times a week for massage of the ankle. Simply because it is plaster and seemingly a little formidable to remove is no reason for leaving a plaster case on for weeks at a

FIG. 18.



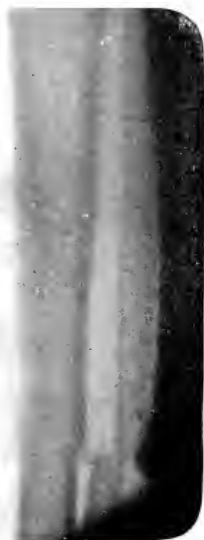
Oblique fracture of fibula.

FIG. 19.



Fracture of fibula and multiple fracture of tibia

FIG. 20.



Same subject as Fig. 19. (Lateral view, showing good position.)

FIG. 21.



Tear-fracture of the antero-external corner of the os calcis, complicating plantar luxation at Chopart's joint.

time. I consider a plaster case almost as easy of removal and application as a muslin bandage. All that is required is a few strokes of a stout plaster scalpel and two or three minutes' time. I know positively that by this method these patients get about sooner with functioning limbs than by the older, careless method of prolonged imprisoning in plaster.

Fracture of Shaft of Tibia.—There were five fractures of the tibial shaft, all from severe direct violence, as a fall or a kick, and all occurring between the middle and the supramalleolar level. These fractures give trouble because of their frequent obliquity and liability to compounding. In simple fracture in which the plane of fracture is conducive to maintenance of position after reduction, conservative treatment is best, and consists of the ten-day fracture box period, followed by a six weeks' gypsum case period, weight-bearing being allowed only after application of a leather splint with side-irons, for it must be borne in mind that, in contrast with the comparatively lighter prehensile function of the upper extremity, the line of union at this site must be strong enough to bear the weight of the entire body. If an oblique fracture be treated conservatively, it is best to section the tendo achillis, to neutralize the tendency to displacement of the lower fragment posteriorly. Two of these cases were plated, and if open operation is indicated anywhere in the body it is certainly indicated in some of these troublesome fractures, in the absence of infection. If the fracture be compound it should be immediately swabbed out with strong iodine and a dressing of dry carbolyzed gauze applied, and, with immobilization, any further manipulation would be meddlesome surgery. After the wound has healed, and in the absence of infection, operation may be performed if indicated. Fractures compounded by the sharp edge of a fragment are, of course, less serious than those compounded by the vulnerating object.

Fracture of Fibula and Tibia.—There were eight cases of fracture of both bones of the leg, all due to severe direct violence, as, for instance, collisions with automobiles. In two the upper thirds were involved, in one of which the external tibial tuberosity and upper fourth of the fibula were implicated, while in the other the plane was oblique from above and within downward and outward for the tibia, while the fibula was involved just below its neck. The

first of these had, of course, a traumatic synovitis of the knee-joint, which considerably delayed reappearance of function. The third patient had a multiple fracture of the tibia, which separated the bone into equal thirds, and a fracture of the fibula opposite the lower of the two tibial breaks (Figs. 19 and 20). A barrel of flour had rolled upon his leg. The fourth patient fractured both bones just below the middle of the tibia, and the latter was plated. After two months there was fibrous union only, and the plate caused irritation and a discharge. The fifth and sixth patients broke their legs opposite the junction of the lowest with the upper three-fourths of the tibia, and both had backward angulation. The remaining two patients had a supramalleolar fracture of the tibia with fracture of the external malleolus. These two cases represented the supreme degree of injury in fractures about the ankle-joint, and a very interesting example of a particularly severe similar injury is described by Murphy (*Surgical Clinics*, 1912, i, No. 6, p. 867). One of these cases was an old fracture when first seen, and had chronic tarsitis and pes planus, which required orthopædic treatment.

In the reduction of fractures of both bones of the leg, Pott's position, in which the leg is flexed on the thigh and placed upon its fibular side, will be efficacious when all other means fail. Tenotomy of the tendo achillis often helps materially for accomplishment and maintenance of reduction. The same remarks apply here as were given for fracture of shaft of tibia alone, for in the treatment of these cases the fibula may be practically ignored, and all efforts bent to secure union of the tibia.

Fracture of Tarsus.—There were six cases of fracture of tarsus. The os calcis was involved three times, two of which were due to falls from a height of 12 feet, and in one of these the tuberosity was separated (compression fracture), and in the other the greater process. In the third case there was a tear-fracture of the antero-external corner of the os calcis, complicating total incomplete plantar luxation at mid-tarsal (Chopart's) joint (Fig. 21).³ The astragalus was broken twice—one a tear-fracture externally, the other a fracture of a spur, the residue of a railroad injury 26 years previously.

³ This case made the basis of a paper which appeared in *Annals of Surgery* for 1913.

The cuboid was involved in one case—a tear-fracture of the antero-external corner from inversion.

Fracture of Metatarsus.—There were three cases of fracture of metatarsal bones, the first and second being involved in one, the first in another, and the fourth in the third. These fractures are relatively infrequent, and are typically caused by the fall of a heavy piece of metal upon the foot. There is usually a more or less extensive deep hæmatoma that puffs the foot up and renders the skin tense and glistening, much interfering with the clinical diagnosis of fracture. This deep hæmatoma must be watched and timely deep incisions made if there is impending ischæmic necrobiosis. I am confident that many of these fractures of metatarsals cannot be diagnosed without skiagram,—at least not until the swelling has greatly subsided. I have seen many patients with foot injured by impact of a heavy weight escape fracture, and yet they presented identically the same symptoms and signs as those with fracture. Therefore, in all injuries to the foot in which violence was appreciably severe it is essential to have a good skiagram, for if there is fracture we must know it in order to preserve the integrity of the plantar arch and obviate flat-foot. In the differential diagnosis luxation at the mediotarsal or tarsometatarsal joints must be considered.

Fracture of Phalanges of Toes.—There were seven cases in which the phalanges of the toes were involved, and in four of these it was the great toe—the proximal phalanx in two, and the unguis in two. In two cases the proximal phalanx of the second toe was involved. In the last case seven phalanges were fractured from the impact of an eight-foot stone. This illustrates another advantage of the X-rays: they often expose more fractures than are clinically suspected. A dressing of sodium silicate suffices for these little bones.

In all injuries of the foot it is important to bestow extra care and attention upon this member. The circulation is dependent and the weight of the body must be borne upon it.

A Surgical Clinic

TUBERCULOSIS OF THE SCAPULA—SARCOMA OF THE FINGER—CYST OF THE THYROID—ENORMOUS HYDROSALPINX—TUBAL PREGNANCY

BY HUBERT A. ROYSTER, A.B., M.D.

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TUBERCULOSIS OF THE SCAPULA RESEMBLING SARCOMA; EXCISION

GENTLEMEN: Our first case this afternoon presents a comparatively rare condition, and one which might be easily confused with a more serious malady. This colored woman, who is 37 years old, was first seen by me almost four months ago. At that time she complained of constant pain at the top of the right shoulder, and said there was a lump in that region. Examination showed enlargement of the entire right scapula, especially on its posterior surface (Figs. 1 and 2). The swelling was tender and had a cystic "feel," but was undoubtedly of bony origin. The woman's symptoms had extended over a period of twelve months, and she had lost flesh and strength.

The appearance of the growth was strikingly like that of sarcoma which not uncommonly occurs in the scapula; but the fact that a family history of tuberculosis was obtained caused me to lean more to the less frequent condition. A few days after she first entered the hospital I made an incision over the scapula and removed portions of the dead bone, which was thin and honeycombed, and curetted the remaining portion, getting rid of many cheesy masses underneath the bone. This was done with the hope of causing a regeneration of bone and arrest of the process. The pathologist reported that the bone was the seat of a tuberculous necrosis.

The patient has now been readmitted to the hospital and it becomes necessary to excise the scapula, because no permanent re-

FIG. 1.



Tuberculosis of right scapula. (Posterior view)

FIG. 2.



Tuberculosis of scapula. (Lateral view.)

FIG. 3.



X-ray picture showing complete destruction of the first phalanx, except at each articular surface, where the cartilages have been more or less preserved. (See frontispiece, for finger laid open after removal.)

FIG. 5.



A large cyst of the thyroid gland; enucleation.

lief or improvement was secured from the curettage and the disease has progressed. You will observe the swelling and the scar of the former operation. We now employ the Langenbeck incision, running first along the scapular spine from the acromion to the vertebral border, then downward to the angle of the bone. Having turned down this flap with its base outward, we proceed to cut away in turn the large number of muscles attached to the scapula, keeping the wound well retracted. There is considerable hemorrhage from the muscular branches. In this case the glenoid portion of the bone is found to be solid and healthy, so we will be able to leave it, and it is not necessary to open the joint. Dividing the dense ligamentous bands between the clavicle and the acromion and pulling the spine of the scapula outward allows us to get a saw underneath and sever the neck of the bone. We have also sawed off the acromial end of the clavicle and sutured muscles over it; and we will now close the other muscles over with chromic-gut sutures and put in a cigarette drain up to the bone left at the joint, and coming out at the lower angle of the wound, which is to be stitched with silkworm gut.

Differential diagnosis between tuberculous disease and sarcoma of the shoulder-blade is not so easy as one might suppose. They are both infrequent affections; they occur in young adults; they present a similar appearance. Sarcoma has its commonest seat in the region of the spine or in the lower part of the body of the bone. The tuberculous process may begin as a primary deposit in the acromion or the glenoid, and the neck may be involved in tuberculous disease of the shoulder. The treatment of the two conditions is quite different. A tuberculous scapula will many times be cured by erosion or partial excision, while sarcoma demands the most radical kind of removal.

GIANT-CELL SARCOMA OF PROXIMAL PHALANX OF INDEX-FINGER;
AMPUTATION

The next patient is Mrs. T. P. S., 33 years of age, referred by Dr. M. P. Perry, of Macon, N. C. She has had five children, the youngest of whom is three months old. Just before the birth of this baby she noticed that her left index-finger began to swell at the base. She does not remember to have injured it in any way. The finger

continued to enlarge and seemed to present a sense of fluctuation, so that two weeks ago the doctor "opened" it, expecting to get fluid, but none appeared. Since then it has been very "sore." It is, as you see, swollen below but not at the tip; it is yet indistinctly fluctuating; the bone cannot be palpated. This X-ray picture (Fig. 3) by Dr. Moncure shows complete destruction of the first phalanx, except at each articular surface, where the cartilages have been more or less preserved. The age of the patient, the rapid advance of the growth, and the information furnished by the radiograph all suggest the diagnosis of *giant-cell sarcoma*. Upon this assumption we shall operate.

Now, I am perfectly well aware of the fact that Bloodgood, Matthews, and others have insisted that these growths are not malignant. These observers do not even classify the so-called giant-celled tumors with the ordinary sarcomata, but regard them as entirely separate and distinct. They prefer that a growth of this kind should be called a "myeloma," signifying that it began in the marrow of the bone. Bloodgood especially advises that, inasmuch as such growths, in his opinion, are benign, they can safely be treated on the conservative plan—curetting or excision rather than amputation. His views carry great weight and should be given serious consideration; he has presented them with strength and candor. Still, it may be doubted (even without throwing an iota of discredit upon scientific work) whether his exact rule may be followed in every instance. At any rate, in the case before us it would seem better to remove the finger.

Making an incision through the skin around the base of the finger and prolonging it downward toward the thumb, somewhat after the "en racquet" fashion, we cut the tendons and come down upon the metacarpophalangeal articulation. As the head of the first metacarpal bone gave a rather light shadow in the skiagram we will amputate just below it. At this point it is comparatively easy to bite through with heavy bone-cutting forceps. A few ligatures are needed for the vessels. After smoothing off the ends of the bone the skin is united with silkworm-gut sutures. Three strands of catgut are inserted for drainage.

As I cut open the specimen (Fig. 4) you will observe that the X-ray afforded a true picture of the condition. The diaphysis of

the bone is completely gone; a brain-like substance, coarse and blood-stained, fills up the space; at the lower end the joint surface has been invaded and the head of the metacarpal bone is enlarged. It could hardly have been possible to save this finger and, even then, it would have been of little use. Undoubtedly the mission of surgery is to spare if we can, to spoil if we must. But there is such a thing as radical conservatism.

A LARGE CYST OF THE THYROID GLAND; ENUCLEATION

This goitre has existed for many years, but did not trouble the woman until a few months ago, when it took on more rapid growth. This suggests malignancy or accelerated cyst formation. It is of the type known as "simple" goitre, and there have never been any "exophthalmic" symptoms. It is very strange to see how reluctant some women are to part with these unsightly masses on their necks, and this patient doubtless would not have come for operation if "choking spells" had not occurred. She now readily consents to have the tumor removed.

The "collar" incision is made and we dissect the flaps upward and downward. The muscles are separated in the middle and drawn strongly to the right. I want to show you how unnecessary it is to cut the muscles across their fibres. Almost every thyroid can be removed without this. Thyroidectomy may be compared to a hysterectomy. In each operation we make the incision, deliver the tumor, clamp or tie the vessels, remove the tumor, and close the wound. No one would think of cutting across the recti muscles in the abdominal incision; why routinely cut the neck muscles in doing a goitre operation?

In this case we have exposed the capsule of the gland and on opening it find that there is just one large cyst embedded in the right lobe. It seems to come up easily, and I believe it can be enucleated without difficulty. It has thin walls and care must be exercised in order not to cause rupture. Shelling it out cautiously, we find that it grows from the isthmus and, clamping it off, we are able to cut across the gland tissue as a pedicle and to lift out the cyst entire. Practically no gland substance has been extirpated; at least, the lobes have not been disturbed. The right one, instead of

being enlarged, is atrophied from pressure and the left is normal. We have ligated some of the smaller vessels and the pedicle of the cyst, and will now close the skin wound, leaving in a very small piece of rubber tissue.

The cyst (Fig. 5), as you will notice, is a large one. It is 6 inches in its longest diameter and 4 inches across its middle. When I hold it up to the light you see that it has transparent walls and contains clear fluid of a yellowish color. This is a rather unusual case. Cystic goitre is common enough, but it is only now and then that a cyst attains a large size and takes up the whole tumor. This patient is lucky.

AN ENORMOUS HYDROSALPINX; REMOVAL

M. B., aged 40, married 25 years, no children; has had very mild pelvic symptoms for a long time—somewhat free menses and occasional pain in lower abdomen. For the past several months she has suffered from a feeling of pressure in the rectum, and, as is usually the case, she says she has “piles.” There is rectal bleeding at times.

Nothing definite is gathered from this history. Examination of the pelvis reveals a very large cystic mass on the left side; the uterus appears about normal and the right side shows no enlargement. cursory inspection of the anal region gives one the impression of a fissure, but there are no protruding hemorrhoids. As soon as we have finished the abdominal operation we will examine the rectum more carefully. It is probable that an ovarian cyst will be found on the left.

Having opened the abdomen, I come directly down upon the mass, and I discover, first, that there is a rather small cyst of the left ovary, but a much larger cystic formation is felt deeper in the pelvis. Getting this up gently, I am now able to demonstrate that it is connected with the Fallopian tube, continuous with it. There are no troublesome adhesions. I have lifted it out and will tie it off both at the uterine end and at the lateral pelvic wall. The removal was easily accomplished without spilling any of the contents. I will now examine the other pelvic and abdominal organs according to our routine practice. The uterus is normal in shape and size; so

is the right ovary. The left tube, however, is apparently sealed at its fimbriated extremity. Reaching upward I feel nothing abnormal in or about the gall-bladder, and the appendix, which I can bring up into the incision, is all right. We have taken out only the left tube and ovary and will now close the wound.

This huge hydrosalpinx—for such is the larger of the two cystic masses—is quite the biggest I have ever seen or heard of. One would naturally mistake it for an ovarian cyst. But you may see that the ovary is entirely separate, as I cut it away from the broad ligament *in situ*. Generally a hydrosalpinx does not attain to such tremendous proportions as this. In its pathology it represents a later stage than a pyosalpinx and is apt to be correspondingly smaller. The very largest pus-tubes are the advanced tuberculous ones. After photographing this tumor we incise the sac and let out the fluid, which, you observe, is bloody. This does not give us leave to call it a hæmatosalpinx; it does not contain blood, but bloody fluid—due to minute hemorrhages from its walls. The total amount of the fluid is two quarts.

Now the abdominal dressing has been applied and the patient is placed in the lithotomy position. I introduce my gloved finger into the rectum and at the depth of about two inches it meets an obstruction, which feels like a foreign body. Manipulating it carefully I bring out this *thorn, an inch in length, which had lodged cross-wise in folds of mucous membrane*. How it got there I do not know. The rectal suffering is easily accounted for.

TUBAL PREGNANCY WITH FETAL SAC IN PROCESS OF EXTRUSION;
SALPINGO-OÖPHORECTOMY

The last patient on the list is a woman who relates a vague sort of history. She is 26 years old, has had two children, and the youngest is five years of age. Her menses have always been free and lately very irregular. She can give no definite account of their appearance. She complains chiefly of paroxysmal pains in the lower abdomen, and says she is weak. On bimanual examination I find that the uterus is enlarged and nodular; that the left pelvis is filled up with a large mass almost continuous with the uterus, somewhat fluctuating and extremely tender to pressure. It is difficult to

make an exact diagnosis. One thinks of uterine fibroid, ovarian cyst, pyosalpinx—one or all; and there is a suspicion of ectopic gestation.

A liberal median incision is made and we come down upon a kind of pathological museum. The uterus contains in its fundus a fibroid of the size of a lemon; there is a cyst of the left ovary a bit larger than a baseball, and just above it is an adherent mass which suggests a gestation sac. I have raised this mass up, and it is undoubtedly a tubal pregnancy. A large foetus with unruptured membranes is being extruded from an opening in the enormously-distended tube. Along the lower border may be seen the fetal arm with perfectly-formed fingers. Clamping off at the uterine cornu and at the pelvic end of the broad ligament, I extirpate the tube mass and the ovarian cyst at the same time. The clamped vessels are now being tied. The raw edge is to be whipped over with a running catgut suture, and the ends of the ligatures are brought together and tied, thus making the broad ligament taut and helping to "jack up" the uterus. I turn my attention now to the fibroid, which I am able to shell out of its bed (myomectomy). The right tube and ovary are normal and will not be disturbed.

THE USE OF IODINE IN ABDOMINAL SURGERY, GYNÆCOLOGY, AND OBSTETRICS

BY J. WESLEY BOVEE, M.D.

Washington, D. C.

GROSSICH,¹ in 1908, published his method of using iodine as a bactericide in surgical work and the results he had obtained therefrom. This report prompted me to employ this agency for clean surgery, and I was at once confronted with considerable injury to the skin from the use of tincture of iodine, U. S. P. It seemed wise and necessary to avoid this sequel, and I began a series of experiments in my operating-room work in association with the late Dr. John S. Neate, microscopist of The Army Medical Museum, looking to the discovery of the weakest solution of iodine that would be reliable as a practical surgical germicide. This was found to be 50 per cent. of the U. S. P. tincture, or $3\frac{1}{2}$ per cent. of the iodine crystals. As an all-important essential of Grossich's method was a dry field to receive the iodine preparation, water was omitted by simply dissolving $3\frac{1}{2}$ parts of iodine crystals in 95 per cent. alcohol, sufficient to make 100 parts.

The report of these experiments was published² in 1911. Meanwhile, I was extending its usefulness, having found that cultures could never be grown from the superficial layers of the skin if the $3\frac{1}{2}$ per cent. tincture had been in contact with it for two minutes. Its application for sterilization of the skin for the use of the hypodermic syringe became, and has continued to be, the routine in the two hospitals in which I work. In obstetric work it promptly became the antiseptic for perineal cleansing, and watery solutions were used for douches and, later, for hand lotions. For intractable fecal fistula and sinuses leading from infected ligatures, etc., a class of cases that formerly seemed formidable, I found the $3\frac{1}{2}$ per cent. tincture always reliable and safe. In none of the several cases of

¹ *Centralbl. f. Chir.*, No. 44, p. 1289.

² *Transactions American Gynecological Society*, 1911, and *American Journal Obstetrics*, July, 1911.

this class which I have treated, employing this agent, have I found even the slightest suppuration or delay in union after operation. Then came the application of this agent to the vagina, the uterine cavity, and, lastly, to the tubal mucosa and the peritoneum. The application of this agent to the internal organs of generation of women was made the subject of my paper read at the meeting of The Southern Surgical and Gynecological Association one month ago. Considering this remedy as the greatest boon to surgical technique of late years, and especially in minor surgery, I feel that its value to those of us not favored with the best surgical environment and facilities cannot be overestimated.

Two minutes' contact with the 3½ per cent. preparation painted over it absolutely prepares the field, while large quantities of a 1 to 1000 corrosive sublimate solution would require twenty minutes to effect even approximately as satisfactory sterilization. Moreover, as perfect sterilization of the hair was demonstrated by these experiments, they need no longer be removed, except for mechanical reasons.

A few precautions are necessary in the employment of this agent. It should be lightly painted on the field and no streams of it should be allowed to gravitate to low points, lest blistering or dermatitis supervene. The field should be as dry as possible when treated, and, therefore, no moistening of the skin for scrubbing or shaving should for several hours precede its use. Nor should any other agent be employed as an aid to sterilization. In fact, it should have our full faith, and the reward will be equally as full.

In preparing the skin as the surgical field two thin coats with an interval of about five minutes or even longer are applied, and for the mucosa usually one heavy coat has been used. As is readily noted, this plan avoids the tedious and prolonged process and the wet and sloppy surroundings which are incidents of the preparation by antiseptic solutions, such as bichloride of mercury.

In surgery of the rectum, perineum, vulva, vagina, and cervix uteri its application is the most simple, reliable, and time-saving of all preparations which I have used, and is the only agent I use for the purpose.

In surgery of the uterine cavity, the Fallopian tubes, and pelvic

peritoneum I have employed it but eighteen months, but the experience therein secured demonstrates its efficacy, simplicity, and harmlessness. I have such confidence in it that I wish to recommend it to you.

In low-grade infections affecting the endometrium I commonly inject an ounce of this iodine preparation into the uterine cavity after thoroughly dilating the cervical canal. This method of treatment has in my work largely superseded curettage. It has become my custom to employ this procedure as a preliminary to opening the peritoneal cavity for the treatment of affections of pelvic structures, such as of the uterus, tubes, ovaries, and the pelvic peritoneum. In this work, however, two ounces of the solution is injected under pressure, care being exercised to prevent a reflux by the syringe nozzle during the process, and the pressure is continued for about two minutes. If the uterus be small, a considerable quantity of the iodine solution will pass into and through the tubes and will be noted on the peritoneal surfaces should the abdomen be now opened. If the uterine cavity be very capacious none of the solution may pass beyond it. In such cases more may be injected through the uterus or into the tube from the fimbriated end. Occasionally, but very rarely, the isthmus of the tube may be impermeable, due to inflammatory action, the presence of a new growth, or some other cause. Very often the fimbriated ends may be occluded and prevent escape of the iodine into the peritoneal cavity. Quite often I find such condition, except that the iodine has mingled with the tube contents, pus, or clear fluid. When the iodine solution has freely passed through the tube and has clearly demonstrated its permeability, the picture as seen from above is oftentimes striking.

As the peritoneum is reached in making the abdominal incision, its color resembles that so commonly noticed when operating for ruptured tubal pregnancy. [This discoloration has many times been to the operating surgeon the first indication that he was to deal with blood lost in the peritoneal cavity]. The peritoneum now being opened reveals a puddle of iodine solution diluted with peritoneal fluid, surrounding or covering the pelvic contents. If the fimbriated ends be patulous they will be readily seen, showing a marked difference in the coloring of the mucosa and the adjacent serosa. Loops of

intestines and the omentum are found discolored by the iodine, and, on the whole, one may be excusably alarmed. But the experience of one or two such instances dissipates such alarm. This picture may be entirely absent where adhesions have buried the tube ends, even though they be patulous at the uterine end. In some instances necrotic areas of the tube have been ruptured by the iodine solution injected through the uterus under pressure. To my surprise I found those patients who had so much iodization had less suffering after operation. In chronic conditions of these organs arising from infections, I have uniformly employed the above procedure, and such surgical treatment as seemed advisable has, of course, been added.

This plan has caused me to extirpate less commonly such unfortunate ovaries and tubes. In acute conditions,—that is, active inflammatory processes,—accompanying infections I have followed the same plan, except that no organs were resected or exsected. The cases have been too few and too recent for definite conclusions to be drawn from them. No additional morbidities have occurred, however, to deter me from further employment of this plan of treatment. In pelvic abscess arising from tubal infection I have in several instances incised the abscess by posterior colpotomy, introduced a self-retaining rubber drainage tube, and then injected the uterus and tubes with 3½ per cent. tincture of iodine.

One should be certain that permeability of the tubes throughout exists, else a considerable amount of iodine and alcohol forced into and retained in the tubes may cause iodine poisoning. In one case that ended fatally in two hours after being thus treated, we were even after autopsy undecided whether the iodine or the alcohol or their combination assisted the shock in determining the result. As I have seen shock alone cause death in these bad cases I cannot seriously blame the tincture of iodine for the untoward result in this case of a very feeble woman who had but one tube, the other having been removed four years before. Of course, when the pelvic abscess is not associated with tubal involvement incision and drainage alone are employed. The future history of these patients suffering from pelvic abscess and in which tubal injection with iodine has been practised will be studied as thoroughly as possible.

At present I am not prepared unqualifiedly to recommend this plan of treatment for such associated conditions, but with my ex-

perience to aid me I have concluded to continue its use. In investigating the subject of the treatment of intraperitoneal conditions by the use of iodine injections, as reported in the magazines, books, and monographs in the Library of the Surgeon-General's Office, I have found among the uncut leaves wonderfully interesting case reports and comments thereon. Of special interest are those from 1824 to 1881. Unilocular ovarian cysts and other fluid accumulations, as empyema of the gall-bladder, were treated by injections of watery solutions of the tincture of iodine containing potassium iodide. Ascites (known as essential ascites), in particular, was thus treated. The dilution of the 8 per cent. tincture of iodine by distilled water varied from one to three to one to nine, and iodide of potash usually entered into the solution employed to about 1 per cent.

To those interested in the subject I would specially recommend A. A. Boinet's "*Du Traitement de l'Ascite par les Injections Iodées*"³; "*Iodothérapie*," 2nd edition, 1865, by the same author; Leriche's case report,⁴ and Velpeau's "*Des Injections Medic. Dans les Cavités Closes*,"⁵

Quantities of the tincture, varying from half an ounce to one pint, were injected, sometimes after dilution and again without dilution. Phillips⁶ injected one pint (B. P.), and after twenty minutes "allowed some of it" to escape. The patient had distressing symptoms, but recovered, dying two years later from the "effects of cholesterin calculus." The history report suggests gall-bladder empyema.

I am not certain that the watery dilutions of iodine for moist serous or mucous surfaces may not be found as efficacious as, and possibly safer than, the 3½ per cent. solution in 95 per cent. alcohol as I have used it. Particularly is this worthy of consideration when a large volume of the fluid is needed, for it requires smaller quantities of iodine. In localized intraperitoneal infections the employment of this tincture of iodine seems to be a safe and wholesome procedure. I have not hesitated to employ it in intestinal resections, gastroenterostomy, cholecystotomy, and appendectomy.

³ *Gaz. Méd. de Paris*, 1851.

⁴ *Journal de Med. de Lyon*, 1847.

⁵ *Ann. de Chir.*, 1845, xv, 257.

⁶ *Materia Med. and Ther.*, Wm. Wood & Co., 1881, i, pp. 76 and 77.

With its freedom from danger and its absolute reliability as a germicide one application should logically supplant the two common applications, one of carbolic acid followed by one of alcohol, to the appendicectomy stump. Surely free applications of this iodine preparation to intestinal fistulæ make their dissection and closure perfectly free from infection and simple as compared with the former elaborate and careful surgical procedures practised for this condition, and which were attended by a high mortality rate.

I have referred to the successful treatment of postlaparotomy sinuses that connected with infected ligatures or pus-pockets. I no longer fear suppuration during healing of wounds made in eradication of such conditions. A typical case that fully tested this plan of treatment was described by me in my paper on this subject that appeared in the July, 1911, number of *The American Journal of Obstetrics*. In the secondary closure of large drainage wounds, even though suppuration was present, I have met with uniform success in applying the iodine thoroughly and freely, denuding, closing with absorbable buried suture, and sealing with collodion. You may understand from the use of the collodion seal that I have full confidence in non-suppurative of the wound. In obstetric practice I commonly paint the mon veneris, perineum, and vulva with a solution half as strong ($1\frac{3}{4}$ per cent.) after the hair of the same has been carefully clipped short and removed as labor sets in. A coating may be applied shortly before examination per vagina is to be made, and the last just before fetal expulsion. It is believed this last application is especially useful whenever a remnant of Neisserian infection of the Bartholinian glands exists. As the perineum is stretched by the presenting part of the fœtus these glands are compressed, and any secretion present will be forced to the surface through their ducts. The vagina may be thoroughly painted if precaution against infection from the canal seems indicated. The urethra may also be thus treated if Skene's glands are suspected of harboring infection. If thorough painting of the vulva is indicated and practised early in labor the patient is allowed to inhale an anæsthetic. For intra-uterine or vaginal douches iodine is employed in watery solution of from 1/70 to 1/35 per cent.

Finally, I state I have temporarily adopted for hand lotion, both

in obstetrical and surgical work, a watery solution of the U. S. P. tincture of iodine—2 drachms to the pint, or approximately 1/9 per cent. At present I am conducting experiments bearing upon the efficacy of this lotion.

At the risk of criticism for devoting so much energy and time to the study of what might be reckoned an insignificant subject, I have taxed your patience and time. But I feel sure that, if you will study the chemical and physical characteristics of iodine and employ it in surgical and obstetrical work as I have done, you will be fully compensated for my temerity to-day.

HEBOSTEOTOMY

BY CHARLES B. REED

Chicago

A DISPROPORTION between the head and the pelvis is the obstacle that confronts the obstetrician in more than one-fifth of his cases. The number of actual disproportions is still further increased by certain malpositions of the head or errors in flexion or rotation that have the same ultimate effect. Even in times when labor was more nearly a physiologic process, this condition cost many lives and inspired thoughtful obstetricians to devise means for its relief.

In the effort to diminish the danger of labor, the balance of safety inclined first to one patient and then to the other, although both were seriously threatened. When both are fully considered, we find that in comparison with other operations hebosteotomy is to be looked upon most favorably, since in five hundred cases recently reported the maternal mortality was only 1.7 per cent. and the fetal 4.65 per cent. (Schäffli, 1909).

This is not astonishing when we reflect that the operation is now settling down to a normal ratio, its performance being properly understood and appropriate cases selected. There is no doubt that many of the early cases were sacrificed to misguided enthusiasm, fallacious reasoning, or an imperfect technique.

The operation must not be regarded as an end in itself, but as preparatory, and hence it should be associated with the competing measures. The idea is to give both mother and child an equal chance for life, so it is imperative to exclude certain conditions of pelvic contraction, certain methods of avoiding the problem, and connect it with those with which it normally belongs. Furthermore, the statistics of combined interference must have an average mortality that is less than the preceding methods of treatment taken singly.

In doing craniotomy on a dead child or a Cæsarean operation where the pelvis measures less than 7.5 cm. the indications are indisputably clear. There remains, however, a large territory, a border

state, where the true conjugate measures from 7.5 cm. to 9.5 cm. This region has long been a battle-ground between the advocates of Cæsarean section, version and extraction, forceps, and the induction of premature labor.

We exclude from consideration, as not pertinent, the evasive manœuvres like artificial abortion and changes in diet that restrict the growth of the child. Artificial abortion is almost as serious as Cæsarean section or hebstectomy, and the child, of course, is lost; while the various dietaries, such as Prochownik's, if successful do not require operation at term, and if unsuccessful leave the conditions unchanged.

Operative interference is most frequently demanded in cases of contracted pelvis, but hebstectomy will in time be a routine measure where malpositions of the head are found either with or without contraction.

The judgment must be highly discriminating in all these forms of dystochia if mother and child are given equal opportunity. Some men frankly deny the fetal interest and resort to craniotomy unhesitatingly, but this is hardly successful obstetrics. It is not fair to mother, child, or attendant, although it may be the easiest solution. Others choose the Cæsarean operation as a facile evasion of the dilemma, but this, too, unless the C. V. is less than 7.5 cm., is unjustified as a routine, although it is far more commendable than craniotomy on the living child.

Each case must be individualized and the indications and conditions carefully weighed before a decision is made. In contracted pelvis v. Winckel's figures give a fetal mortality of 20 per cent. when the case is left to nature and 35 per cent. when terminated by forceps or version. The inference is obvious, although it is only fair to believe that the cases artificially managed must, of necessity, have been more serious originally.

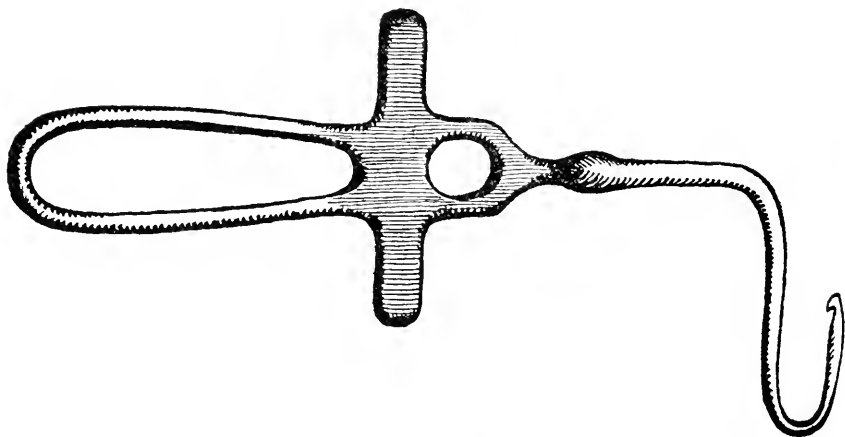
Induction of premature labor is almost as destructive, since 30 per cent. of the babes die at birth or within a few months thereafter. While recognizing the peculiar value of this measure, we must again insist that it be reserved for selected cases.

Several operations await our choice where a woman at term has a C. V. of 7.5 cm. to 9.5 cm., or a child so large that the pelvis is relatively diminished. These are Cæsarean section, forceps, version

and extraction, or hebstectomy, or the latter plus forceps or version. At the lower margin is Cæsarean section for relative indications, which become more pronounced as the size of strait diminishes until it is absolute. At the other side is forceps or version and extraction, which presses more urgently as the diameter increases and the head is fixed or floating.

The choice is guided not only by the pelvic measurements, the size and shape of the pubic arch, and the notoriously uncertain estimates of the fetal head diameters, but also by the length of time the woman has been in labor, whether or not she has been examined, and whether she is infected. The normal resistance of the

FIG. 1.



The Doederlein saw-carrier.

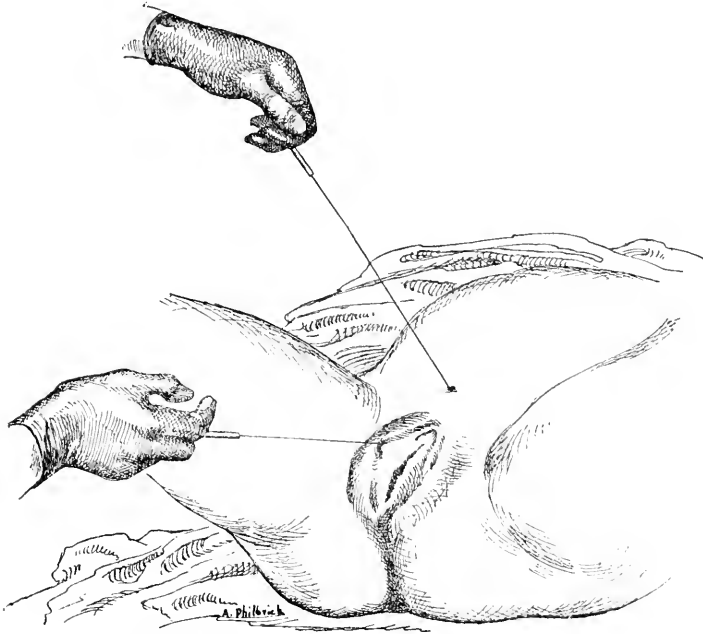
woman and the condition of the child are other factors of great importance. To ascertain these significant facts requires so much time, energy, skill, and experience that even specialists will sometimes prefer the easier outlet by Cæsarean section if the patient's consent can be obtained. This is always the result, and justly, if the attendant's experience has been surgical rather than obstetrical.

Version and extraction is attended by a high fetal mortality (33 per cent.), partly due to the version, but more especially to dragging the child through the narrow bony strait by force. This must be evident to anyone who has employed the Smellie-Veit manoeuvre, with the woman in the Walcher position and an assistant pressing down on the head from above.

The same conditions are present where axis traction forceps are employed, except that both patients are more constantly and more seriously endangered (maternal mortality, 5 to 8 per cent.; fetal, 40 per cent.).

Something must yield when a head of the same or larger calibre is forced through the pelvic ring. By muscular activity, by the powerful downthrust of the head, and by the looseness of the joints,

FIG. 2.



The saw in place during the performance of hebstectomy.

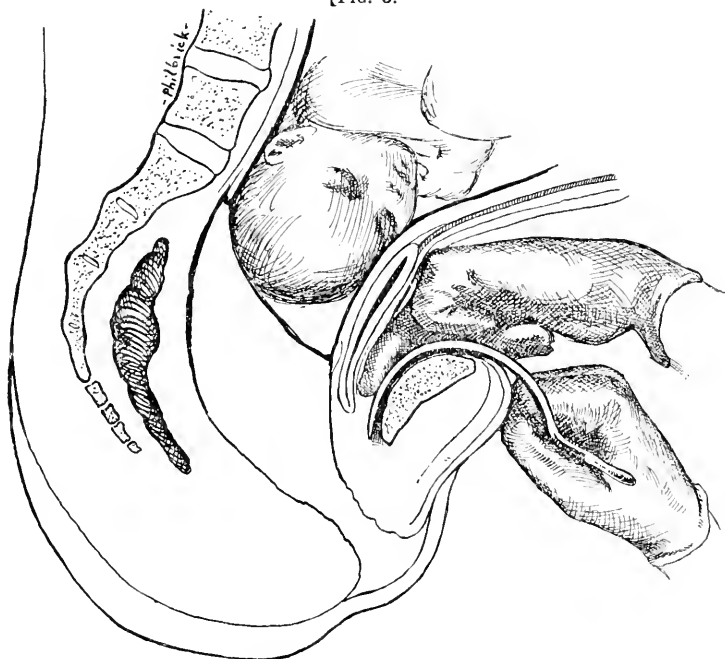
some enlargement is secured, and more is added by the Walcher position, but we cannot know always in advance whether the space will be sufficient.

The writer believes that the axis traction instrument is too brutal in operation and too often fatal to the child to be used without a preparatory widening of the pelvic ring. If this cannot be done, then craniotomy of the living child or Cæsarean section must be seriously considered. This is true, though in a less degree, of version and extraction.

Inasmuch as a separation of 8 cm. between the ends of the

bones after hebosteotomy increases the anteroposterior diameter by 2 cm., we can secure usually all the room needed for any delivering operation. In certain cases, also, the woman may be allowed to deliver spontaneously. It seems logical then to employ hebosteotomy in all cases where a spacial disproportion exists, if careful pelvimetry indicates that the child may be seriously endangered by the operation selected for delivery.

[Fig. 3.]



Hebosteotomy by Doederlein's method.

If this seems too radical, let the operator modify it by introducing a silk ligature by means of the hebosteotomy needle. Then the saw may be quickly put into service when the trial of forceps or version shows it is doomed to fail.

This much we owe to the child. What of the mother? In spite of figures, our experience leads us to conclude that maternal morbidity and mortality may be decidedly diminished by a properly-done hebosteotomy in appropriate cases. The operation should be avoided in a primipara if possible, for the activity and continuance of the pains are uncertain. Vigorous pains many times will over-

come a disproportion that would demand forceps or version with weaker contractions. In these cases, however, the rights of the mother must not be denied if the trial of labor seems fruitless. Moreover, in every case the operation should be done before maternal exhaustion renders any interference dangerous. The same intelligent judgment that governs the choice of operations on other parts of the body should control us, and the decision and performance should not be postponed through timidity.

The indications for hebosteotomy must be broadened to include malpositions of the head in normal pelves, such as brow and face (mortality for mothers 6 per cent., babes 25 per cent.), be the chin anterior or posterior, if delivery does not occur in a reasonable time, the condition of mother and babe being always the criterion. The manœuvre is more dreaded from its newness and from the complications that are sometimes associated with it than justice and simplicity of technic would warrant.

Hemorrhage is usually quite free, but readily controlled by compression. Failure to obtain room for delivery after dividing the bones is due to a lack of judgment in choosing the method of operating. Injuries to urethra or bladder are generally due to bungling technic or operative incompetence.

It is probable that the improper and injudicious use of low forceps results in a larger percentage of injuries and more serious traumatisms than occur in hebosteotomy. Yet forceps are universally popular. When both are done by equally skilful operators, or with the same frequency, it is probable that the percentage will be more nearly alike. The technic of hebosteotomy is simpler than forceps and far less brutal in its consequences. When both are used the danger of injury is necessarily increased, but the guilty factor must be industriously differentiated.

In this as in every surgical interference sepsis must be feared. Laceration of the soft parts that extend from vagina to the fresh wound may be produced by the passage of the child. This is a real danger and quite comparable to an instrumental laceration of cervix and lower uterine segment. The partially subcutaneous operation done with a blunt needle of the Doederlein pattern has given very good results, and the writer sees no reason to abandon it. (Figs. 1, 2, and 3.)

One might summarize the indications and conditions for the operation about as follows:

Conditions as preparatory to delivery when—

1. The pelvis has a certain size—C. V. 7.5 cm. or more, depending on size of fetal head.
2. The child is living and viable.
3. The soft parts are yielding enough not to tear after loss of bony support.
4. The birth canal is aseptic.
5. A trial of labor has occurred.
6. A good surgical environment is possible.

Indications for cases of disproportion between head and pelvis when above conditions are present—

1. Preliminary to use of axis traction forceps.
2. Preliminary to version and extraction.
3. To widen the pelvis in expectation of spontaneous delivery.
4. In brow positions.
5. In face position, with head in the pelvis and chin either anterior or posterior, if careful attempts at delivery fail.
6. Posterior parietal bone positions.

Obstetrics

THE PREVENTION OF ECLAMPSIA

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THERE are at the present time several outstanding problems in obstetric practice in the sphere of treatment: there is the question what form of management gives the best results in accidental hemorrhage and in placenta prævia; there is the settlement of the claims of forceps, version, induction of premature labor, pubiotomy, caesarean section, and craniotomy in contracted pelvis; and there is the whole subject of how best the grave complications of pregnancy are to be dealt with. When, further, it is remembered that the last-named problem includes the treatment of such dangerous maladies as hyperemesis gravidarum, chorea gravidarum, and eclampsia, it will be recognized that it most urgently calls for settlement.

IMPORTANCE OF ECLAMPSIA

Of all the grave complications of pregnancy, eclampsia, by reason of its sudden onset, its frequency, and its fatal result, is that which most exercises the mind of the obstetrician; and such a discussion as that which took place at the annual meeting of the British Medical Association at Liverpool in 1912¹ shows not only how interested the profession is in the matter, but also how far away a solution of the problem of the best management of the malady seems to be. It was significant, for instance, that the discussion was a conjoint one, the sections of pathology and of obstetrics and gynæcology both taking part in it; there were no less than fourteen speakers, of whom three presented carefully prepared papers and the others

¹ *Brit. Med. Journ.*, ii, 1912, pp. 1122-1130.

nearly all used the full time allotted to them; more than three hours were thus fully occupied, and there were no silences, one speaker following another in rapid succession. It was also significant that so many plans of treatment were named and considered, for it may be taken as almost axiomatic that multiplicity of methods of treatment spells a high mortality, and that in its turn means ignorance of causation.

ETIOLOGY OF ECLAMPSIA

To me was assigned the duty of opening the subject and of dealing specially with the question of etiology; and I must admit that I found it no easy task. Indeed I was so impressed with the confusion of theories which a study of modern obstetrical and pathological literature revealed to me that I made a plea for an entirely new plan of research in connection with this malady. I pointed out that whilst there were many theories of pathogenesis—those in which the causative toxæmia arose inside the uterus and those in which it had its origin in some organ outside the uterus—they all had this in common: that they presupposed the presence of pregnancy with its modifying effect upon the metabolism of not one part of the system alone, but of every part of it. Many things appeared in the foreground of the subject, so to say, but the background was always the same; many organs might be accused of being inadequate or defective, and kidneys, liver, intestine, thyroid gland, adrenal glands, parathyroids, and mammary glands, all were named and blamed; but it was always in association with pregnancy that their failure was considered. So I came to the conclusion, was driven to it by a survey of all the facts, that *the master problem was pregnancy itself*.

When one comes to think of it, how little is clearly and surely known of the physiology of pregnancy! It is no exaggeration to state that although it is well ascertained that the presence of the embryo and later of the fœtus in the uterus profoundly influences the expectant mother's whole system, making her literally tingle to her very finger-tips with the new life that is in her, yet the knowledge of how exactly her organs and tissues react to the intra-uterine stimulus is sadly lacking. Some general facts are known of the

changes in the blood and bones, in the liver and kidneys, in the thyroid and parathyroids, in even the skin and nails of the pregnant woman; some more particularized information is forthcoming of the alterations which gestation effects in the uterus, the ovaries, and the mammary glands; but there is nothing like an accurate acquaintance with the finer histological changes in the organs and tissues (such as the blood and nervous system), and indeed the story of the biochemistry of the nine wonderful months in which mother and unborn infant are so much to each other is only beginning to be spelled laboriously out. Observers like Abderhalden and Leith-Murray² are acting as pathfinders and are even making some progress in laying open the mysterious way in which these two lives, maternal and fetal, brought temporarily into such intimate relationship, are influencing each other; how, for instance, in pregnancy the maternal blood seems to acquire protective powers to enable it to resist foreign proteins coming to it from such an organ as the fetal part of the placenta (polarimetric reactions); but much remains to be done.

THE PROBLEM OF THE PHYSIOLOGY OF PREGNANCY

This being the case, pregnancy being the main cause, so to speak, of eclampsia, and so little being known regarding the intimate nature of the tissue changes and biochemistry of pregnancy, surely it is not irrational to demand a concentration of investigation upon the physiology of pregnancy. It seems to be necessary to study the mechanism of the normal before that of the abnormal can be understood. A great deal of time and much energy have been spent in trying to find out why one pregnant woman in five hundred develops eclampsia, and it is now proposed to attempt to discover why the four hundred and ninety-nine other pregnant women do not develop that condition. This raises the old question, is pregnancy a disease? At the present time, it must be admitted that there are some observers who still hold the opinion that the unborn infant acts in a prejudicial way upon the mother who carries him in her uterus, and that pregnancy is a sort of prejudicial parasitism against which the maternal organism is forced to develop or to perfect pro-

² *Journ. of Obstet. and Gynæc. of the Brit. Empire*, xxiii, p. 87, 1913.

fective mechanisms; and in immunity reactions and the like it has to be allowed that they find some evidence in support of their contention. When a woman comes safely through her confinement it is customary to give thanks that she has been kept well and safe "in Nature's hour of danger"; but if the above view be correct it will be necessary to regard her as in peril during all the nine months which have preceded that hour. The other opinion is that which Professor Bar and others have done much to build up. It views pregnancy generally as a state of harmonious symbiosis, as a condition in which the fetal life within the maternal life forms on the whole a beneficial association of vital energies. It is admitted that it is a time of stress and strain, but it is maintained that the maternal system is in the great majority of cases able to respond to all the demands made upon it, and that at the end it emerges no worse, but rather better and stronger for the testing it has received. Professor Bar³ furnishes very striking chemical and physiological evidence in support of his conclusions. But it must at once be conceded that this state of harmonious symbiosis is very easily thrown out of harmony. So long as there is *fœtus sanus in matre sana*, to use Bar's striking phrase, so long all goes well; but as soon as there is a break in the health of either the fœtus or the mother, then the harmony is destroyed, and the risks of hyperemesis, of chorea, of eclampsia, and of other morbid gestational states has to be faced. The point at issue really limits itself very exactly to one question: Is physiology working at high pressure and under high strain (for no one denies that even a normal pregnancy is a severe test upon the structural and functional integrity of the mother) to be accounted pathology? The answer to this question awaits the investigations of the physiologist and the biochemist.

TREATMENT OF ECLAMPSIA

In the meantime, however, the treatment of eclampsia calls for consideration and cannot be delayed until the status of pregnancy (so to say) has been fixed; even although the physiology of gestation is imperfectly understood, it is necessary to keep on trying to reach a satisfactory way of dealing with eclampsia and other pathological complications of the pregnant state.

³ *Leçons de pathologie obstétricale*, Paris, 1907.

PREVENTIVE TREATMENT

Prevention is proverbially better than cure; but, unfortunately, it does not enter into the statistics of eclampsia. It ought to do so, and it is worth considering whether some plan cannot be devised for estimating the number of cases of threatened eclampsia which are now being stopped short of the development of convulsions by preventive treatment. It may be possible to agree upon the symptoms and signs of the pre-eclamptic state, and upon the degree of severity of these which indicates impending convulsions, and so be able to gauge the proportion of cases in which prophylaxis has been successful. I am convinced that during the past few years the treatment we have been able to give in the Edinburgh Royal Maternity Hospital to pregnant patients exhibiting the prodromata of eclampsia has been the means, in a large number of cases, of preventing the incidence of fits and so of saving these women from the gravest dangers of renal inadequacy; but these cases do not enter into the eclampsia statistics of the Hospital. In the future I hope to record them as "threatened eclampsias averted." I shall fix a standard of severity of prodromatic symptoms, taking the amount of albumin in the urine and the height of the blood-pressure as indices in arriving at this standard, and I shall place all morbid pregnancies which show the required degree of gravity in a group of "threatened eclampsia."

It is somewhat unfortunate that the name prophylactic or preventive treatment has sometimes been given to Stroganoff's method of dealing with eclampsia. It would accord better with the nomenclature in use in Britain and America if it were named the medical treatment of eclampsia; for it is employed after the fits have begun, and is not, therefore, directed against the pre-eclamptic state. It is a very successful method of treating eclampsia, and has given up to the present time the best results; but it is not prophylaxis in the ordinary sense of the term.

THE PRE-ECLAMPTIC STATE

When a pregnant woman begins to suffer from persistent headache, from dimness of vision, from puffiness of the skin of the face and hands, and from a diminution in the amount of urine

passed; when albumin appears in her urine, accompanied or not by tube casts and blood; when the urea falls in amount; and when her blood-pressure begins to rise; she is in the pre-eclamptic state, and is in danger of developing convulsions. Of all the warning signs albuminuria is in my opinion still the most important, and I have ventured to call it the C.Q.D. (Come Quick, Danger) among the signals which indicate trouble in a pregnancy and call for help to avert disaster. If this be granted, and it can scarcely be resisted, then the onus of watching for this danger signal rests upon the medical man whom the pregnant patient has chosen to look after her in her confinement; of course he cannot recognize albuminuria unless he tests the urine; and, therefore, it follows that he ought to examine the urine not once, but at regular intervals during the pregnancy, and immediately if any of the other premonitory symptoms present themselves. He ought to feel that he is in charge of the patient from the moment when she engages him to attend her. Too often it is otherwise: the doctor takes a note of her name and address, calculates when the confinement is to be expected, and thinks no more about her till he is sent for with the oncoming of the pains of labor. What he ought to do is to give her some little notion of the natural and unnatural phenomena of pregnancy, more especially ought he do this if she be a primipara; he should ask her to send a bottle of her urine regularly to him for analysis, fixing a definite day in each month and two days in each of the last two months for the dispatch of the specimen, and giving her the dates written clearly on a memorandum form; he should make a duplicate note of the dates himself, and if in the following months the specimens do not arrive punctually he should send reminders. The medical man who takes these precautions may earn for himself the name of being faddy; but his patients will feel that he is really watching over them, and he himself will be spared, sooner or later, the extraordinary anxiety which always accompanies the management of a case of eclampsia, and possibly also the reproach which always attaches itself to the death of a woman in labor. In addition to arranging for the receipt and for the analysis of specimens of urine—for it need hardly be added that the medical man must not neglect the testing of the specimens sent to him—the doctor should explain to his patient the symptoms which indicate a departure

from healthy conditions in pregnancy. He should tell her that persistent headache, long continued morning sickness, or sickness in the later months, sudden diminution in the amount of urine passed, depreciation in her power of vision, and swelling of her fingers preventing the removal of her rings are not the natural events of a pregnancy, and ought consequently to be reported to him without delay. He may, if he so chooses, give her some printed information about the preparations for labor and the normal and abnormal phenomena of her condition; but, to my mind, the essential thing is that he should feel himself responsible for his patient's well-being from the day she consults him and engages him, and that she should recognize that he has accepted the responsibility and feel that she is really under his care.

Similarly, maternity hospitals should accept no less a responsibility. Every maternity hospital should have a ward for the management of the diseases of pregnancy and especially for the preventive treatment of eclampsia. Patients applying to such an institution and found to be suffering from any of the prodromata of eclampsia should be pressed to come into the pregnancy or pre-maternity ward for suitable treatment. Such a ward has been in use in the Edinburgh Royal Maternity Hospital since 1901; and I have supervised the management of many cases of albuminuria in it. Hardly one of these patients so treated developed eclampsia, although many of them would almost certainly have done so if they had been living in their own homes. In a leading article in the *British Medical Journal*⁴ this sentence recently appeared: "We wonder in how many maternity hospitals in this country pre-maternity or pregnancy wards have been established since the plea for such things was published in these pages in 1901"; the question thus asked has so far elicited no reply.

THE MILK-ONLY DIET

But whether the preventive treatment of eclampsia be carried out in the patient's own home or in a maternity hospital, the first step is the same. It consists in placing the patient upon an absolute milk diet. Obviously it will be much easier to have this restricted diet enforced in a hospital ward than in a private house; indeed it

⁴ *Brit. Med. Journ.*, vol. i, 1913, p. 298.

is very difficult to make sure that the rule of milk only, of milk for breakfast, dinner, tea, and supper, is being obeyed. Even with the addition of a little magnesia to it nothing but milk for a number of days is apt to become very distasteful; and few patients in their own homes carry out instructions on this point with strict integrity. Yet it is of great importance. It is now nearly forty years since Professor Tarnier pointed out the value of the milk-only diet in prevention of eclampsia, and many other obstetricians, including Pinard,⁵ have substantiated this statement; and still many patients suffering from eclampsia come into hospital who have not received this simple (albeit distasteful) preventive treatment. The milk may be given hot or cold, it may be pure or mixed with plain water or potash water, and it may be creamed or uncreamed. It must be given in sufficient amount to sustain life; three or four tumblerfuls a day are not sufficient. When milk alone does not at once begin to have a good effect, it may be replaced with milk-water, "*l'eau lactosée*," which consists of 50 grammes of milk to a litre of water.

OTHER PREVENTIVE MEASURES

If begun in time the milk-only treatment may in itself be sufficient to ward off eclampsia in these albuminuric patients; but in other instances the convulsions are so imminent that other means require to be adopted. Further, such comparatively simple measures as rest in bed in an atmosphere of not less than 68° F., the keeping of the bowels open, the safeguarding against all forms of excitement, and the administration of diaphoretics and diuretics, although good in themselves, will not meet the necessities of a really grave case. By a really grave case I mean one in which, despite the employment of the means I have mentioned, the blood-pressure remains high (170 to 190 or more), the urea is markedly diminished, the urine is practically solid when boiled, acetone appears in the urine, and the headache, epigastric pain, and eye symptoms are unrelieved. Albuminuric women have been described as "*candidates for eclampsia*," and in such cases as I am referring to they are pressing candidates indeed.

Such grave cases demand correspondingly strong treatment if

⁵ *Jour. méd. franç.*, p. 14, January, 1912.

they are to be prevented from passing on into convulsions. I have, therefore, in recent years, begun to treat them as if they had actually developed eclampsia; and I am convinced that in some cases at least I have succeeded in staving off convulsions. When I have been successful the patient has of course not been counted as having had eclampsia; and so I have lost the benefit of these cases in my statistical tables, but that is not a matter to be regretted if the end aimed at was attained, *viz.*, the prevention of fits and consequent saving of life.

It is not always necessary in such resistant cases to use all the means employed in eclampsia patients, and one or two or perhaps three out of the six measures which I regard as essential in a well-marked case of convulsions will usually be enough in these threatened eclampsias. This leads me to describe the method of treating eclampsia which I have come to rely upon during the past four or five years, and from which I have got better results than ever before.

Some years ago I contributed an article to the *CLINICS* ⁶ on what I named "the contingent treatment of eclampsia." In it I argued for greater differentiation in the management of convulsions in labor, and at the time I thought it might be possible to separate cases into groups according to causation, and to give to each group an appropriate but slightly different treatment. I now freely confess that this was a premature suggestion; our knowledge of the causation of eclampsia is not complete enough to enable us to make any such differentiation. Accordingly I give to all serious cases the six means of treatment which I am about to name, and thereafter I try to distinguish different types to a certain degree.⁷

Stated briefly, the six things are: (1) venesection from one of the veins of the arm, to the extent of ten or twelve ounces; (2) transfusion into the vein so opened of saline solution or (more recently) of a solution of calcium chloride, to the extent of two or three pints; (3) the washing out of the stomach with sodium bicarbonate solution (1 drachm to the pint); (4) the running into the stomach of a large dose (as much as 6 ounces) of magnesium sulphate with sufficient water to dissolve it; (5) the giving of a copious

⁶ *INTERNATIONAL CLINICS*, ser. xx, vol. ii, p. 153, 1910.

⁷ *Brit. Med. Journ.*, II, 1912, p. 1124.

enema of castor oil and soap and water; and (6) the use of the hot pack. I have got better results from this method of treatment of eclampsia than from any other; and during the four autumn quarters (1908-1911) during which I had charge of the Royal Maternity Hospital I treated 31 cases of eclampsia thus with three maternal deaths (9.6 per cent.). I have given up interfering with the uterus save in most exceptional cases, and have used morphine and thyroid extract much less than formerly; indeed the six measures I have named above have sufficed in most instances to produce a good result. Ordinarily chloroform is used to enable some of the six procedures to be carried out; but in cases in which there is acetone in the urine it is omitted. Perhaps I ought to add that in private as compared with hospital practice it may be found impossible easily to use all the six methods, and under these circumstances I think reliance should be placed on morphine and chloral, given in such a way as Stroganoff suggests.⁸

Now in cases of threatened eclampsia, when the milk-only diet is insufficient to remove the premonitory signs and symptoms of convulsions, I have been in the habit of using some of the six above-named measures. One might conceivably have to use them all, but that will be rare; still in a very severe case I should not hesitate to employ them all, for I should feel that I was probably only anticipating the treatment I should be compelled to adopt later by the oncoming of fits. In a considerable number of cases of albuminuria in pregnancy I have got good results from the use of some of the six measures; thus in a married woman in the Royal Maternity Hospital (prematernity ward) last August (1912), there was albuminuria (1.75 grains per ounce), the blood-pressure was 220, there was a fall in the urea excretion (3 gr. per oz.), and there was swelling of the face and legs, headache, etc.; she was put upon milk-only diet, was given a large dose of magnesium sulphate, and was put in the hot pack; the blood-pressure fell first to 180 and then to 174, and the urea increased to 5 and then to 6 grains, whilst the amount of urine, which had been a little over 34 oz. in the twenty-four hours, increased to 47, 97, 67, and 120 oz. in the following four days; labor then came on and the patient was delivered of a

⁸ *Brit. Med. Journ.*, II, 1912, p. 1128.

premature female infant weighing 3 lbs. 12 oz.; the mother's blood-pressure thereafter fell to 120 or 130, and she made a good recovery; the infant was brought up in the incubator and also survived. Another patient, a primipara, was under treatment for pre-eclamptic signs in the prematernity ward for six weeks (in August and September, 1912); she was given preventive measures, gave birth to twins prematurely, and made a good recovery, but one of the infants was still-born. In this instance the treatment seemed as if it was having no effect till it was discovered that the patient's friends were surreptitiously supplying her with varied food from outside.

CONCLUSIONS

Let me now summarize the preventive treatment of eclampsia which I have endeavored to state in this article.

(1) In the absence of accurate knowledge of the cause (or causes) of the toxæmia which leads on to eclampsia and to some other maladies of pregnancy, it has become necessary to go back a stage in our investigations and study afresh the physiology, and especially the biochemistry of normal pregnancy; when we shall have discovered the real nature of pregnancy, whether it is harmonious symbiosis of mother and infant or is a state of prejudicial parasitism of the fœtus upon the mother, we shall be much better able to understand, and consequently to treat, the abnormal developments of pregnancy, such as eclampsia.

(2) For the purpose of studying pregnancy, normal and pathological, it is necessary that our maternity hospitals be furnished with wards for the reception of pregnant women at various stages in gestation; since such patients require an entirely different regimen and diet from the puerperal women, it is desirable that they have a ward or wards to themselves; and each hospital ought to have on its medical staff a man well versed in biochemistry as well as in pathology.

(3) Meantime, since prevention, in the case of eclampsia, is much easier, and very much more satisfactory than attempted cure, the signs and symptoms of the pre-eclamptic stage should be carefully watched for and promptly dealt with; this means that the medical attendant upon a pregnant woman should take the patient under his

care and supervise her health long before her actual labor is due; in other words, the medical profession should, much more than it does, regard itself as responsible for the proper management of pregnancy.

(4) There are several premonitory signs and symptoms of eclampsia, such as diminution in the amount of urine and of the urea in it, rise in the blood-pressure, œdema of the face and hands, headache, epigastric pain, defective vision, etc.; but the presence of albumin in the urine is (so to say) the C.Q.D. of the danger signals which nature flashes to us when convulsions are imminent; therefore whatever else be omitted in the care of the pregnant woman the regular analysis of her urine must not be forgotten.

(5) The mere supervision of pregnancy, entailing as it does the early correction of errors in diet or in hygiene, will by itself prevent many an eclampsia; and in the case of hospitals no such supervision is possible without a pregnancy ward.

(6) Should, however, the prodromata of eclampsia appear, the first step in the preventive treatment is the immediate placing of the patient upon a milk-only diet, and keeping her on it till the albumin has become a trace and the blood-pressure fallen to normal; this treatment, along with such simple means as the regulation of the bowels and skin, will often be in itself all that is needed.

(7) If the milk-only diet be insufficient to cause the disappearance of the premonitory signs and symptoms, then one or more of the six measures used in eclampsia itself may be employed in order to prevent it; these six measures are venesection, transfusion, stomach washing, the introduction of magnesium sulphate into the stomach by the tube, a large enema, and the hot pack.

(8) The induction of premature labor will rarely be necessary, although it may sometimes follow the treatment recommended.

Medicolegal

RAPE IN CHILDREN AND IN YOUNG GIRLS

BASED ON THE PERSONAL INVESTIGATION OF SEVERAL HUNDRED CASES OF RAPE AND
OF OVER FOURTEEN THOUSAND VAGINAL EXAMINATIONS

PART I

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INTRODUCTORY REMARKS

Is the crime of rape on the increase? I would say decidedly that it is. Certain moving-picture shows and the environment of the patrons in nearly all instances undoubtedly are provocative of sexual thoughts. The increase of picnics and excursions, where the young are allowed the utmost freedom, are responsible for many cases of rape. Following the celebration of the Fourth of July, 1912, I examined five young girls, all of whom had been assaulted on that holiday. The laxity of mothers in failing to inform their children in regard to sex forces the child to self-education in such matters. The high cost of living tends to overcrowding and underfeeding. This brings out the animal qualities in both old and young. Not enough food and fuel drives men to drunkenness, which in turn is a common cause for attempted assaults. The underpaid girl is tempted by the underpaid boy to find some diversion, something without money-cost, which will give them a little momentary gratification. The poor man with his family is driven to take in a boarder who is unknown to him, and here develops a condition which often ends in the rape of the daughter.

All of us are aware, although some would not admit it, that the underpaid, overworked mill girl, chorus girl, and salesgirl—indeed, most of the hard-pressed girls in all occupations—are constantly

fighting to protect their virtue. I mean that they are almost daily tempted by men to live easier, dress better, and have a few extra comforts in exchange for the sale of their body. My investigations show that in almost all instances where the victim was very young and helpless the defendant was a sexually-degenerated old man. It is unnecessary to go into reasons for this.

The young colored girl and boy do not appear to have any moral sense. Overcrowding in our tenement districts breeds sexual crimes, and the sending of young female children to neighboring shops alone and unprotected is a potent factor in multiplying the opportunity for assault. Many of my cases had such a staging for the crime. While a mother cannot protect against the brute who attacks while the child is coming home from school, she can minimize the danger by not allowing the child to go out unattended except when absolutely necessary. What we need most is the careful education of the young in the great question of sex and morals, and the more drastic punishment of the guilty.

Rape has been defined as "The unlawful, carnal knowledge by a man of a woman against her will and without her consent; or the carnal knowledge of a man of a female child under the statutory age of consent." By carnal knowledge is meant penetration, to the least extent, of the female genitals by the male organ, but does not necessarily imply the actual emission of semen.

The age of consent varies somewhat in different States.¹ The latest statistics which I am able to find are in Weyssé's translation of Thinot's "Medico-legal Aspects of Moral Offences" (F. A. Davis Company, 1911, p. 24). Alabama and Mississippi, ten years; Kentucky, Louisiana, Virginia, Wisconsin, twelve years; Iowa, thirteen years; Illinois and Indiana, fourteen years; Texas, fifteen years; Massachusetts, Michigan, Montana, New York, Oregon, and Pennsylvania, sixteen years; Colorado, Kansas, Missouri, fourteen (if not previously chaste); Nebraska, fifteen (if not previously chaste); Tennessee, twelve (if not previously chaste); Washington and Wyoming, eighteen years.

¹ Note the different periods set as the age of consent in various Southern States and remember that puberty arrives earlier in the South than in the North. In England a boy under fourteen years of age is considered incapable of committing rape. This is accepted in some American courts.

From the same treatise I take the following: "The punishment for rape varies in different States, which may be grouped as follows, according to the nature of the penalty: (1) Death: Arkansas, Delaware, Mississippi, North Carolina; (2) Death, unless the jury sees fit to make the punishment imprisonment in the State's prison for a term of years (varying usually from one to twenty years): Alabama, Florida, Georgia, Kansas, Maryland, Missouri, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; (3) Imprisonment in the penitentiary for life or a term of years: Arizona, California, Colorado, Connecticut, District of Columbia, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, Wisconsin, and Wyoming."

THE GIRL'S HISTORY OF THE ALLEGED ATTACK

While procuring the history of the alleged assault we must be particularly wideawake in a careful study of the child herself. Much may be gained by close observation. Those familiar with such cases need not be cautioned against unreservedly receiving the girl's statement as accurate or truthful. Many girls will use every means possible to mislead, and their endeavor to evade the truth is at times surprising, and even wonderful. To those unfamiliar with such examinations I would suggest that they listen carefully to the various stories, perhaps fables, which even very small girls will often relate with apparent truthfulness. All statements must be weighed, as they may influence your judgment after the examination. It is always a good working rule to be guided only by the physical conditions that present themselves to your eye and finger, and to forget what the sense of hearing has suggested. As a matter of fact, the girl's statements often amount to nothing. I have had them freely acknowledge having had sexual intercourse a number of times, when the hymen would not admit the tip of the little finger; and again others have strenuously denied coitus where two fingers could easily be inserted, these same girls afterward admitting misconduct for years past. Many of these girls lie as easily as a morphine fiend.

Not long since a beautiful girl of fifteen was brought to me for examination. She had run away from home and her parents desired to be sure "that nothing had happened to her." She was of the highest moral repute, of a very good family, and her apparent modesty appealed to me strongly. The closest questioning on my part was rewarded by absolute denial of any wrongdoing, and she was horrified and shocked at my suggestion of making an examination, but finally consented. I found the hymen obliterated, the vulva gapping, and a relaxed vagina, easily admitting two fingers without the slightest pain. She was informed of this condition and advised to tell the truth, which was that she had been living in a house of ill-repute for six weeks and had had sexual intercourse times without number.

Again, such cases have been presented where coitus was not only freely admitted, but the minutest details explained, yet the examination has shown a virginal condition of all the tissues, and the fact is obtained that some adult has tutored the child for the occasion, usually for financial gain or a desire for revenge. A number of odd and unfortunate affairs have resulted from such procedures, which I can illustrate by giving three cases in brief from my own experience, showing ignorance, overanxiety, and criminal fraudulency on the part of the witness.

A little girl was brought to me and gave the following short history: "Five days ago a man living in the same house took me up to his room, and did dirty things to me. He put me on the sofa and got inside me and put his hand over my mouth, and said he would kill me and my mother if I told anyone." The examination of the child showed a profuse non-gonorrhœal discharge, with some excoriation of the thighs, swollen and exquisitely tender vulva, with the hymen ruptured in all directions. The girl could hardly walk on account of pain, and was altogether a pitiable object. I examined the man with negative results. He freely admitted that he had taken the girl to his room, but could not remember what had happened, as he was under the influence of liquor at the time.

Another was a case of a ten-year-old girl who accused a married man of fifty-nine with having had sexual intercourse with her on several occasions within two weeks previous to my examination. A girl friend, who claimed to have been present at the time of the assault, told in vivid terms what had happened, and the child's mother was most bitter in the denunciation of the man, whom she declared to be positively guilty. On the testimony of the girl, and that of a physician who testified that she had been entered, that man was held by the Magistrate without bail for court. It was at this time that my attention was first brought to the case, and an examination of the prosecutor convinced me that, although the hymen was undoubtedly lacerated, it was not one of recent date. The history of the case bore me out by the girl admitting self-abuse and coitus with a boy friend. The examination of the man disclosed the astonishing fact that he had undergone a complete operation of the penis, for sarcoma, at the Pennsylvania Hospital, in Philadelphia, three years previously. This case

demonstrates the value of making an examination of the accused whenever possible.

The third case was of a girl and her sister, ages ten and twelve, who accused a night-watchman of sixty of having had sexual intercourse with them on several occasions. The two girls told the same story, and both were certain that the man had completed the act. The younger girl showed some redness about the vagina and a slight discharge, the hymen being unbroken and slightly inflamed. The elder had a marked laceration downward to the right, and also had a discharge which was quite abundant. The discharge of each was evidently due to uncleanness, as no gonococci were found on microscopical examination. The man gave me the following interesting history: "Five years ago I was operated upon because I could not pass my water, and was in bed six weeks; my left arm was amputated about eight years ago, following a railroad accident. I have been in very poor health since my last operation. Have not passed a drop of urine through the penis for over four years, and have not had an erection for over three years, and am in continual pain from the pressure of my clothes on these running sores." Examination showed a scrotum the size of a large egg-plant, with two discharging sinuses; also another sinus in the perineum, which discharged urine and pus. The penis was shrivelled up and could hardly be seen among the folds of the scrotum, and had apparently an impervious urethra, while the scrotum was exquisitely tender to the touch and was wrapped in cotton, most of which was soaked with the foul-smelling mixture of pus and urine. The man looked considerably older than sixty, walked with effort, and of course denied any wrongdoing. He gave as a reason for the accusation "that he used to give the girls tickets to a theatre, which tickets had been given to him by a customer, but lately had been unable to do so, as the man had left town." Perhaps the most interesting feature of this case is the story told me by the older girl, which is "that he had sexual intercourse with me ten times within the past two years. He used his finger at first, and then a candle, but I did not know he was swollen or had sores, or I would not have let him do it. He wanted a boy to do it first to make me larger." The Society for the Prevention of Cruelty to Children in Philadelphia had some time previously investigated the family of these children and found that the mother was a hard drinker and totally unfit to look after the children, who had run wild for two years. Unfortunately I cannot state definitely the outcome of this case, but I am under the impression that he was convicted of indecent assault, which I believe has no definite meaning, so far as the law is concerned, but which may be understood as maltreatment of the prosecutor.²

²In Witthaus and Becker, vol. ii, p. 662, Wm. Wood & Co., Edgar and Johnston in their chapter on rape give the following: "Assault.—The law regards a handling, a touch, or an attempt to touch by a male any part of the sexual organs of a female, genitals, or breasts (or even her lower extremities in some States) without her consent, as a criminal assault. It applies as well whether they are covered with clothing or not. Physicians are not likely to be called as witnesses in these cases, except in the communication of disease, syphilis particularly."

The records of law and medicine are full of similar cases. We find them grading from these extreme incidents to those that blend so closely with doubt as to make it a difficult matter indeed to determine the true from the false, the fraudulent from the legitimate. As physicians we must be close observers, and in the subject under consideration doubly so, for the whole aspect of a child's life, and the conviction of an innocent man or the escape of a guilty one, frequently hinges on our testimony. Even to the point of being over-cautious, I urge upon you to be on your guard regarding a girl's statements of her sexual history, and under no circumstance should her story bias us in forming an opinion. Girls may affirm with all the apparent evidence of truth that their young lives have been pure and innocent and that contrary suggestions are insults to their chastity. These same girls may later confess to wrongdoing after the physician has found positive evidence of destruction in tissues, evidence which leaves not the slightest doubt either that the girl is absolutely ignorant as to matters sexual, or else believes herself clever enough to mislead you. It would seem that the truth is told about once in thirteen cases.

At times the law desires to know something regarding the menstrual history of your patient. In this climate the usual menstrual life is between fifteen and forty-five, but cases have been reported where its onset was in the tenth year and continued to the eightieth. Williams ("Obstetrics," J. Witridge Williams, p. 74, D. Appleton & Co.) mentions the case of Ann Mummenthaler, who, according to Haller, "menstruated regularly from her second year, and gave birth to a full-term child at the age of nine." Another case reported by Hirst ("A Text-book of Obstetrics," p. 69, W. B. Saunders & Co.), "who had under his charge a girl, fourteen years of age, impregnated by her brother, aged thirteen, who had stimulated his sexual desire by masturbation."

As to the sexual ability of the male, it may be placed between fourteen and sixty-five. Of course, there are cases of precocious sexual development and of sexual ability in very old men. It is said that de Lesseps, the French engineer, impregnated his wife when over eighty years of age. In a book on "Medical Jurisprudence" by J. Chitty, published in 1836, Part I, p. 385, I find the following: "Thomas Parr, who married at the age of 122 and lived until he was 152, did penance for an illicit amour at the age of 102."

I have a list before me of eight well-known gentlemen who have been blessed by offspring at more or less late periods of their lives. Three were over sixty years of age, one seventy-two, one eighty-seven, and another eighty-nine. There is one of eighty whose wife presented him with twins, and one of eighty-one who did likewise, while yet another who at eighty-two found himself the proud father of triplets.

THE EXAMINATION OF THE GIRL

During the examination of the prosecutor all persons present must refrain from answering questions put to the child, and in no way, by word or gesture, suggest to the patient what her answers should be. The presence of the mother or father will often greatly interfere with your obtaining a reliable statement, unless they are cautioned to reply only to queries put directly to them. Too often they lead the girl to misstatements and untruths. We ourselves should be very careful not to mislead, and to feel certain that she understands the exact meaning of all our questions, avoiding any medical terms which might confuse her, and especially avoiding all queries of a leading nature until her complete history of the assault has been procured.

While procuring a history of the attack it is often difficult to ascertain whether the girl has been actually entered or not, and this arises from several causes. (1) At the time she was probably terrified beyond reason. (2) She was suffering physical pain from the handling of the man, and may be unable to state where the pain was located. (3) She believes that penetration has taken place on account of the close proximity of the penis to the vagina. (4) She was so far mentally and physically exhausted from her struggling that she can tell you little or nothing regarding the whole procedure. (5) In some instances the man has assured the girl that he has not injured her, and by threats or promises has made her believe that such is the case.

Even to the point of seeming crude I must insist that in any examination as to the girl's knowledge of sexual matters, especially as to the exact assault in question, any mawkish sentiment as to delicacy must be put aside. It is absurd and ridiculous to expect a nine- or ten-year-old girl to answer with any intelligence the questions put to her by members of the bar, and, I may add, at times by

physicians. Has this man ever had sexual connection with you? Has the defendant ever had carnal knowledge of your body? Or has the man in the dock ever had sexual relations with you? The poor child shakes her head and wonders what it is all about. She has not the slightest understanding as to the meaning of such words; in fact, she does not know who or what is meant by the "defendant" or the "dock." Several times I have requested to be recalled as a witness to explain this to the Court. I have seen physicians go far astray in their notations in these cases for the reason that they take it for granted that the girl understands the medical terms for the sexual act. Another common error is the question, "Did this man have anything to do with you?" This question in itself means nothing, and may be construed by the girl to mean anything. It frequently will be found that the girl's understanding of this question is something far different than anything sexual. Many times in my own cases the child has admitted the sexual intercourse with the man, or that the man had forced her to have carnal knowledge with him. Almost without exception it will be found that these children have been tutored to use such expressions, and further investigation discloses the fact that the girl meant "that the man did dirty to her." This often resolves itself into the fact that the man had his hand under her dress and had in no way attempted to have sexual connection. To the vast majority of these young girls there is no such word as penis, and the array of *nom de plumes* for this organ is too great to even attempt writing the list. I have long ago given up trying to call the sexual act or any of the organs connected with the act by any terms which are proper and correct. I found the histories and facts seldom agreed, and in the question of rape we want to have, and must have, facts. I feel that some women agents of certain charitable organizations believe that I have little modesty or even decency in my manner of asking certain questions. I myself have been mildly amused at their shocked expression, and have felt it due them that I explain my reasons. As a matter of fact, I allow the child to tell her story in her own words and way, and then have several rehearsals of her story. Should she use the technical words, such as sexual connection, carnal knowledge, coitus, etc., I quiz her thoroughly as to the exact meaning of her expressions, frequently finding that she is absolutely ignorant as to this point. I

then ask her to tell me the exact details of what the man did and a precise statement of her own actions. This is frequently rewarded by a fairly concise description of the sexual act. In many cases the child is so frightened or nervous that she has to be led step by step, and it is here that my apparent lack of modesty asserts itself. Ascertain the precise position of the man and girl at the time of the assault. Were they lying down; on a chair; was she on his lap; or were they standing up? The last question is very important, as I have had little girls of seven or eight years of age and about four feet five inches in height tell me that the man and herself were standing during the act, and then have examined the defendant, a six-footer. Did the man undo his pants? Did he take something out of his pants? What do you call this that he took out of his pants? Exactly where did he put it?—giving the name as expressed by the girl. Are you sure he was inside your body or just between your legs? Always ask if the act hurt her, and if she bled at the time. Get the girl to describe any motions of the man, and if her clothing or skin was wet or stained. Ascertain the length of time the man had the girl alone, and how long a time it took to perform the act.

Naturally, it is impossible to suggest any definite mode of questioning in examining these cases, as each will be found to require special judgment in your manner to arrive at a satisfactory conclusion as to the girl's knowledge of matters sexual. Experience has taught me the necessity of conducting the examination of the girl, as to the exact facts of the assault, in the simplest possible language.

It will be found of the greatest aid in the investigation if the confidence of the patient can first be gained and if she can be influenced into willingness to undergo the examination. It should be remembered that the subject is not an adult with fully-developed reasoning power, but a sensitive, ignorant, and often fear-stricken child, who is usually impressed by a gentle manner and by persuasive words. Once assured that she will not be caused unnecessary pain, she will often give her entire co-operation and make the procedure much more satisfactory and easy for both herself and the physician. Should she be old enough to understand, I have found it good policy to explain the importance of having the examination and

of how much it may help her should the case go to court. But, at the same time, she should be made to understand that the evidence may be used against her.

Before proceeding with your examination invariably determine if she has been previously examined. If she has been, then procure the physician's name, address, and the date of the examination, and learn as to whether a digital exploration was made or a speculum introduced.

The patient should be made as comfortable as possible, lying on her back with the heels resting on the edge of the table, and all the clothing should be loosened about the waist; in fact, the clothing should be so arranged that an abdominal examination may be made when necessary. If the girl wears corsets and drawers, these should be removed and the latter closely inspected for blood and seminal stains; this, of course, applies only to those cases examined shortly after the assault and where no change of clothing has been made. The diaper of infants should be subjected to the same inspection. Very small children may be examined on the mother's or nurse's lap. In some instances it will be found best to have all the clothing removed, as by so doing marks of violence, if any, may be found. This, however, is not often necessary, as such evidence, if existing, is usually to be found on the legs, arms, throat, or in the region exposed during the examination.

Young girls seen within two or three days of the assault frequently show a mode of walking which is very suggestive of some sexual mischief or local traumatism. The child stoops, walks with the legs apart, and has a halting gait. There is a drawn, anxious facial expression. The gait and expression are very much like those seen in women suffering from pelvic abscess. It is also always prudent to use your eyes before using the finger, as much may be gained by noting the following points: Are there bruises or marks of any kind on the legs, hips, or in the region of the vagina; any inflammation, abrasions, or ecchymoses suggestive of finger pressure or nail scratches? Are the labia majora firm-looking, symmetrical, and are they in close apposition, covering the urinary meatus and underlying tissues; or do they appear relaxed, swollen, red and gapping, exposing the deeper parts? Should there be any leucorrhœa

present, note its color, odor, amount, consistency, and whether it excoriates the thighs. A greenish-yellow discharge is commonly present in young girls, following sexual intercourse, appearing within two or three days. It is apt to be profuse, has a distinct odor, is ropy in consistency, and stiffens and stains the clothing; at the same time excoriating the thighs. In infants this excoriation is aggravated by the urine bathing the abraded surface. The etiological factor is usually traumatism, and the amount of discharge depends largely on the amount of trauma. The first suspicion is, of course, that this discharge is gonorrhœal, its appearance being very similar. Consequently the necessary microscopical examination should be made to determine this question. Keep in mind that a gonorrhœal discharge rarely manifests itself until the third day, and commonly from the third to the eighth day after the assault. The extension of the inflammatory process to the urethra and rectal tissues will cause the patient to complain of painful urination and defecation. The former is a very common symptom of gonorrhœa. In gonorrhœal infection of the vagina the urethra is almost invariably inflamed, while in discharges from other sources this is not so frequently the case.

Many ignorant women believe that a purulent discharge from the vagina is invariably a sign of impure intercourse, and their child is brought to a hospital with the statement that she has been outraged, simply because there is a discharge. Not infrequently a mother comes to the police authorities to procure a warrant for some man's arrest following the discovery of a vaginal discharge in her child, which arouses her suspicions. It is a regulation of the Department of Public Safety in Philadelphia, and a very good one, that warrants cannot be issued in these cases until the child has been examined by the police surgeon on duty. Indeed, as bearing on the importance of the rule, I may cite the case of a man who served six years of a twenty-year sentence for rape on a girl of eight years of age. The man was pardoned because the girl made a similar charge against her father, and examination by the physician disclosed the astonishing fact that there was no sign of even an attempt having been made upon her, the hymen being intact, and conditions showing conclusively that she was a virgin. Had the Philadelphia ruling been in effect in this case an innocent man would not have spent six years in prison.

Should you decide to make a digital examination it is best to first take smears of any discharge which may be present. The smears should be four in number and are best obtained by an applicator wrapped with sterile cotton. Just posterior to the urethra is a good point to obtain these smears. The slides, after being fixed by heat and labelled, should be placed where they will be free from dust contamination. After taking these smears any external discharge should be gently wiped away and the labia majora and minora separated with the forefinger and thumb of the left hand, the amount of heat and resistance of the tissues being noted.

The following conditions can be determined: Is the vagina large or small for a child of the patient's age? Are the tissues hard and firm, or soft and yielding, also are they tender to pressure? Are there any manifestations of chafing, abrasions, or sores, or ecchymosis, and are the vessels congested? Is there any bluish discoloration of the vaginal mucous membrane? and, lastly, is the hymen swollen or inflamed, and is there any laceration of its tissue?

Naturally, when examining small children, we do not expect to find evidence of marked resistance, bruises, scratches, finger-marks, etc., as the little one is incapable of self-protection. Again, in older girls such evidence, other than that found about the genitals, is usually lacking in those who, at the time of the assault, were under the influence of alcohol, narcotic drugs, ether, or chloroform, and in this class are included the cases suffering from coma, hysteria, and hypnotism, or those who have been rendered unconscious by a blow or strangulation, as also are those who have been attacked by several men during the assault. I would especially call your attention to the fact that terror in itself may cause a functional paralysis that tends to make the girl incapable of resistance.

It is quite as obvious that the undeveloped tissue about the vagina will show extensive injury, especially of the fourchette and the posterior commissure, if penetration has been accomplished, which is rarely the case in these small girls. In so far as my records are concerned, in all cases under twelve years of age the lacerations and injuries were of the most pronounced character.

It is a physical impossibility for a full-grown man to penetrate completely the vagina of a girl under seven years of age unless there has first been mutilation by some instrument. These last are the

most horrible cases brought to us for examination. Certainly where the accused is a young boy we do not expect to find such pronounced traumatism as would be present were he a grown man. Regarding these very small children, my own records show that the surcharge is, almost without exception, "Assault and battery with intent to ravish." These cases are the ones attacked by an old sexual degenerate, and the act is usually to accomplish the orgasm between the child's legs, frequently on the drawers, which are not removed. Another point is that the assault often takes place in the child's own home, or in some neighboring laundry, shoeshop, candy store, etc. The accused is frequently a man employed by the child's parents or a boarder in her house. This is a good point to keep in mind, as it frequently leads to the discovery that the child's mother or father is not on friendly terms with the accused, and the mother or father may make a false charge for revenge, or for the extortion of money.

During your examination, should you find any abnormal condition, carefully note the exact size, location, number, and general characteristics of any sore or abrasion, with the length, depth, and direction of any scratches, wounds, etc. Determine whether a bruise or scratch is recent or old, and if its appearance agrees with the date of the alleged assault. This last is a point of importance, as we seldom find little children who are free from bruises or marks of some kind.

If the hymen is found lacerated, which is frequently not the case in young children, on account of its deep situation, note the precise location, direction, length, and whether it is single or multiple; also as to whether the laceration has the appearance of being of recent date, and if the edges are thin, moist, and raw, or thickened and retracted and non-sensitive to pressure.

The extent of the laceration varies according to its cause and to the amount of force encountered, from the slightest nicking to complete destruction of the hymen, with mutilation of the entire vaginal and rectal tissue. These injuries may be so trifling as not to cause the slightest pain or so severe as to cause death, and it is important to remember that the internal mischief may be so great as to kill the girl with very little evidence of external injury. Where the laceration is multiple it is usually downward on both sides and equal in extent, and this appears to be particularly true when lacerations are

caused by sexual intercourse. Tears made by the finger do not, as a rule, show this evenness of extent, and are often found in the anterior portion of the hymen. I have seen a few cases where the hymen was lacerated by masturbation and the tear was most often found to extend upward to the patient's right. This cause for a laceration may be put down as a very rare occurrence.

In some of my examinations, made at the request of the family physician, I have repeatedly been able to correct the statement "that the hymen was not lacerated." The reason for their failure to discover the laceration was brought to my attention some time ago, and is as follows: The child is nervous and involuntarily stiffens her body, contracts her abdominal muscles, and holds her breath, consequently the vaginal orifice is closed by atmospheric pressure. Having the legs widely separated, it is only necessary to place the tips of the forefingers on the lower border at the base of the hymen to allow the air to enter the vagina, when the hymen will bulge out, disclosing any laceration which may be present.

Unless there is some special indication I would advise against the introduction of a speculum. If for no other reason, the admission on the witness stand that such had been used could be, and has been, urged as the cause of the laceration. No matter how far from the truth this assertion may be, the mere showing to the jury of an instrument of this character might give the impression that it caused the injury. There are some adult virgins in whom a speculum can be introduced without injury to the hymen.

In some cases the local inflammation causes such exquisite tenderness that even separation of the labia majora is out of the question, while in others the child is so terrified that an examination is only possible with the aid of an anæsthetic. In regard to making an examination during the menstrual period, I have this to say. While in clinical practice we do not, excepting in rare instances, make such examinations at that time, in criminal cases we should not wait until the cessation of menstruation, as by so doing we may lose valuable signs and symptoms. Again, the bleeding may have arisen from lacerations, or the patient may claim she is menstruating to avoid the unpleasantness of an examination.

Under no circumstances examine a patient without a competent witness present. The reason for this is twofold: First, it is a com-

fort to the patient; secondly, it is a protection to yourself, "as the charge of rape is one easily brought, hard to prove, and still more difficult to protect one's self against." A girl who has had sexual intercourse is in possession of all the medical evidence necessary, and all she has to do is to make a charge of assault against you to procure your arrest. Physicians are in constant danger of having this charge brought against them.

It must always be remembered that no one can compel the victim to undergo an examination against her will without being guilty of assault, though in some States, as in Pennsylvania, the physician has the legal right to make such examinations in girls under sixteen years of age.

During the examination it is especially important to avoid touching the clitoris, as I have seen this so upset a patient that further attempts to complete the examination were useless. Those who have had considerable experience with such cases know the difficulty encountered with those not wishing to be examined. I have had a little girl of six years make it practically impossible to examine her, and this not from fear, but because of a determination not to be examined. I insist on a second examination, whenever possible, unless I am satisfied that the case is a negative one, or in those cases in which there is the slightest question of doubt, and cases where the question of venereal disease is not positively answered to my satisfaction at the first examination.

The more patients I see the more I am impressed with the fact that *we seldom find cases of rape in healthy, robust girls in possession of their faculties and who are above the age of fourteen, provided they were not a willing party to the assault.* This may appear to be a bold statement, but it must be remembered that the mere crossing of the knees absolutely prevents penetration, and, taking into consideration the tremendous power of the pelvic and abductor thigh muscles, a man must struggle desperately to penetrate the vagina of a vigorous, virtue-protecting girl.

It must be thoroughly understood that an attempt to rape may have been made without leaving any physical evidence, and, although legally it may be proved that such is the case, yet we are unable to give evidence to this effect, and we are bound to be cautious of opinions unless there are found positive physical signs of the attempt.

In the cases where the marks of violence were not extensive in character they will be found lacking in nearly all instances after two weeks following the attack. I mean by this that scratch marks will have disappeared, bruises faded, and all other symptoms of an acute character will be absent; but where a laceration has occurred the hymen will never regain its original appearance, though it will have healed pretty thoroughly within fourteen days. Even where evidence of physical violence is lacking we are frequently asked hypothetical questions by the Court, and can only answer as to probabilities or possibilities in any given case. As a matter of fact, our testimony is largely a question of whether the hymen has or has not been lacerated. As to a question of law, this has little or nothing to do with a conviction for rape, as the law does not require any such condition, but merely proof of vulvar penetration. Nevertheless, it is often difficult to demonstrate to the jury, where we find the hymen intact, that a rape from a legal standpoint has been committed. A statement to this effect strongly suggests that the charge should be dismissed, unless it also be carefully explained that, where injury to the fourchette or posterior commissure or other soft parts is detected, from a medical standpoint, the evidence is quite as positive as in those cases in which we find injury to the hymen itself. Just what has caused the laceration discovered is, in the vast majority of cases, impossible to state, but there are certain well-defined signs of physical violence which enable one to say that something has penetrated the child's vagina, destroying or mutilating that safeguard to virginity, the hymen. The law determines, by the evidence submitted, whether it is a case of rape, or a condition due to one or another of many causes, as it is well known that there are cases of penetration without laceration. At the same time the point which is most bitterly fought is the one of integrity of the hymen. Of course, the hymen itself as a sign of virginity is of little value, because its rupture is not necessarily a sign of sexual intercourse, nor its presence a positive sign that intercourse has not taken place.

The hymen may be only partially developed or destroyed in early childhood by a strumous vaginitis or noma pudendum, and it has been claimed by some that this membrane may be totally absent, although such reports, I believe, are the result of faulty examination. I express the opinion that every female will present, on close ex-

amination, the hymen entire, the hymen lacerated, or the remains of the hymen in all instances.

Edgar and Johnston quote Orifila in 200 observations; Tardieu in 500; Devilliers in 150; Fredet in 50; and 176 examinations of their own, a total of 1076 cases, where the hymen or the remnants of it were found invariably to be present. My own observations bear out these figures in all my cases. There is an inflammation which attacks the labia minora and the anterior surface of the hymen, due usually to uncleanness or the presence of some foreign body, which causes considerable itching. In attempting to allay the itching the child may destroy the hymen. It may also destroy the hymen in attempting to soothe the irritation of seat-worms. Wetridge Williams tells us that among certain Eastern races the hymen is ruptured in early childhood for purposes of cleanliness.

The hymen usually ruptures during the first intercourse and most frequently at its posterior border, the extent of the laceration depending on the elasticity of the membrane and the amount of force encountered. In girls up to thirteen years of age the hymen rarely admits the tip of the little finger, while usually in girls of fifteen a normal hymen will permit the passage of the index-finger without discomfort, and one a trifle larger may admit a small male organ without rupture.

The various descriptions of the different forms of the hymen are confusing and unnecessary for the subject under consideration. It will be sufficient for the purpose of this paper to consider the hymen as composed of mucous membrane, reinforced by more or less fibrous tissue; a crescentic septum which, as a rule, includes the posterior portion of the vaginal outlet, its concavity being directed upward and forward. Anatomically it separates the external genitals (vulva) from the vagina. Its opening is directed upward and varies in size from that of a pinhead to that of an aperture easily admitting the finger, as above stated. This membrane varies considerably in form, dimensions, and structure. It may be so delicate as to be transparent and rupture at the slightest touch, so elastic as to be pushed in front of the examining finger, as a finger glove is pushed within itself, or its density may be so great as to require some surgical procedure before sexual intercourse can be accomplished. In the infant it is in most instances deeply situated, but has been

seen protruding from the surrounding tissues. In the adult virgin its situation may be extremely shallow, but almost invariably hidden by the external genitals. In some cases it has been seen as a flaccid fold which was pushed upward and thinned out.

Let us for a moment contrast the normal appearance of the external genitals in a virgin with those of a woman who has had repeated intercourse. I use the word repeated for contrast. The virgin's labia majora are firm, symmetrical, with the lips in close apposition, covering the urinary meatus and deeper parts. The labia minora, or nymphæ, are usually symmetrical, small, are not exposed, and of a pinkish-red color. The clitoris is small, the prepuce not covering the glands, and is also of a pinkish color. The hymen is one of the many varieties and is usually sensitive to the touch.

The signs of repeated coitus are a greater development of the labia majora, which are thick and parted. The nymphæ are enlarged and protruding, their moist surfaces becoming like epidermis, and the rose-color brownish from exposure to the air. The clitoris is often enlarged and swollen and the vagina dilated, with its surface smooth, having lost its rugose appearance. A long-standing leucorrhœa, if profuse, may cause this rugose condition to disappear.

It is rather a difficult matter to determine what we should tell the child's parents or guardian following our examination. The vital point of interest to them is the question, Has or has not the child been entered? Is she still a virgin? Naturally, where an attempted assault has been committed the mother and father are inflamed with a desire for revenge and vindication, and it is difficult to make them calmly reason and see the essential conditions which have to be met in the effort to bring justice to their child.

Those responsible for the bringing up of the girl cannot understand the position in which they place their child when the case comes up in court. There may be an effort made to blacken her character, and her family will be criticised and condemned in many ways. The child's reputation for chastity may be challenged, and an effort made to class her as a girl of ill-repute. There are some who will never forget the child's story of her downfall and unjustly bring up the scandal years after the assault. The trial in court is in itself a distinct shock to the girl's nervous system.

It would not be wise to even suggest any definite plan as to how

much or how little the physician should explain to the family the result of his examination. We must be guided by the circumstances in each individual case. Keep in mind that these small children may say anything which is suggested to them by the prosecuting or defending attorney, and the law recognizes a child's imagination and the possibility of its being tutored. The law also knows that the parents are not in that quiet, unbiased mental state to give testimony as to conditions which are exact as to facts. This is reasonable and to be expected under the existing conditions. I may say this is especially true as to the mother of the victim.

I have not arrived at any satisfactory conclusion as to my manner of explaining my findings to the parents of these children. I may, however, make one or two suggestions, based on several hundred cases of my own.

Where I find evidence of physical injury to the soft parts of the vagina or hymen, which strongly indicate that they were produced by some blunt instrument, I invariably explain the probability as to the cause of the condition found. I believe we are justified in those cases where the child gives a likely and intelligent story of the assault, and where we find frank evidence of injury, and that the physician is well within his rights to endorse the swearing out of a warrant for the arrest of the accused.

In those cases, especially in very young children, where the local injury is of doubtful nature I always give the child the benefit of the doubt. Unless you are certain—and you ever should be—as to the cause of this doubtful injury, why tell a mother that her child has been ruined when you know how very difficult it would be to prove an assault in court?

CHEMICAL AND MICROSCOPICAL EXAMINATION OF SUSPECTED STAINS

I have had submitted to me for examination various articles which have become stained during an attempt to rape. These stains are caused, as a rule, by semen, blood, leucorrhœal discharge, or a mixture of them. The most frequently offered articles are the undergarments of the girl or those of the accused, although it may be a bit of wood, glass, leaves, a sheet, or a handkerchief. The results depend somewhat on the freshness of the stain, and this is particularly true of those stains from seminal fluid, as the most important

finding is the spermatozoön—not a head or tail, but an entire, unbroken sperm-cell. The spermatozoön is about $1/500$ to $1/600$ of an inch in length, with a head about $1/9000$ of an inch in length. It has been estimated that it can travel nearly its own length in one second, and that in a single ejaculation there are over 226,000,000 germ-cells.

In a large number of tests I have arrived at some very satisfactory conclusions concerning these stains, although at this time I do not feel that such results would be accepted as absolute, the present-day dictum depending upon the finding of the spermatozoa.

For discussion we will take up the physical characteristics of such a stain, which we will say is on an undergarment. In size this stain may be that of a three-cent piece, or there may be several stains, each as large as the palm of your hand. Invariably it is found to penetrate the fabric, if this be thin and absorbent, and as invariably it is found to be irregular in outline. It does not have any distinctive color, but is usually of a grayish-lead tint, and it may be yellowish or even red from admixture with blood. The stain is more easily seen when held against transmitted light, and has a starchy feel, with perhaps, if fresh, the characteristic seminal odor. Excepting the last, these indications in themselves are not of the slightest value, as most albuminous fluids, especially leucorrhœal discharge, have similar characteristics. The evolving in such stains of a yellowish tint and seminal odor by the application of dry and moist heat has, in my experience, been very unsatisfactory. The development of a yellowish color without precipitation, through the addition of nitric acid to a solution made from the stained fabric, is not satisfactory. On the other hand, I have found what is known as the "Florence" test to be of the greatest value and to be depended upon in making tests for seminal fluid. The reagent is made of potassium iodide, gramme 1.65; iodine, grammes 2.54, and water, 30 c.c., and is used in the following manner:

Should the stain be only a day or two old and of fair size, allow a portion to soak in a watch-glass with several drops of distilled water for several minutes, then gently dab and shake the fabric over a glass slide, allowing two or three drops to remain on the slide. If the stain has aged, cut out the central part of the most pronounced stain, place it in a watch-glass, with as little handling as possible, and add a few drops of a solution containing hydrochloric acid, three drops to the ounce of water. Allow the fibres to stand without disturb-

ing for at least thirty minutes and then remove several with forceps and proceed as above. It is now a wise procedure to examine carefully for spermatozoa, using a diameter of not less than 500. While keeping the eye to the objective allow a drop of the iodine reagent to run under the cover-slip, and in about twenty seconds or sooner the characteristic crystals make their appearance (see Fig. 1). By applying heat to the under surface of the slide these crystals disappear, to again appear, often enlarged, on cooling. They are seen as a shaded brown color on a pale-yellow background.

I have made the above tests with saliva, blood, urine, faeces, leucorrhœal discharge, egg emulsion, lecithin solutions, and solutions containing phosphorus, and have failed to find their characteristic reaction in any.³ I feel at the present time that this test, next to that which results in the finding of an entire spermatozoön, is the one to be most depended upon, and we may state positively that the stain is seminal wherever we secure the above reaction. The spermatozoa are extremely fragile and soon lose their tails, but to those familiar with the appearance of the head the evidence is rather convincing, though not to be accepted as absolutely diagnostic. The reagent referred to makes a very good stain for the spermatozoa and causes them to be more easily seen. In examining any substance for spermatozoa there is one very important point to remember. Never give an opinion on a specimen until it has become dry. I have found that when the water and iodine solution have evaporated the spermatozoa are much more easily seen. In moist specimens I have seen two or three sperm-cells in a field which when dry shows perhaps as many as twenty. The accompanying plate is from an original drawing by the writer, and shows the Florence crystals and spermatozoa. (Fig. 2.)

Tidy ("Legal Medicine," vol. i, p. 204) states that the spermatozoa have been found in stains six months old. I do not know how long a time the seminal stains may age without giving the "Florence" reaction, but I have found it thirteen months after my first examination of a specimen, and it was as typical then as when

³ It is claimed that any substance containing cholin will show these crystals. These are probably iodine compound of cholin, and where this latter can be excluded the test for seminal fluid is positive. Should it seem best to stain the spermatozoa, soak the fragment in 30 per cent. alcohol and then place in watch-glass containing 1 per cent. eosin. This, when examined dry, will show the heads of a dark red, and tails of a lighter red, color. The oil immersion lens allows a closer study in detail of these sperm-cells and crystals.

fresh. Should the stained article be a bit of wood or some other non-absorbent material, a scale can be easily removed by a knife-point or needle and the tests made as above.

In patients seen very shortly after the assault we may be able to obtain living spermatozoa from the vagina, where, it is said, they will retain their free motion from one to two and one-half weeks. In cases seen within this time it is wise to gently swab the vagina and take several smears for microscopical examination. In any case where there is matting of the pubic hair, remove several hairs for microscopical examination. Of course, where the accused is very young or very old we do not expect to find the spermatozoa, and it is a matter of fact that in some healthy married men, fathers of children, the spermatozoa may be totally absent at times from the semen.

Seminal stains may be found anywhere on the clothing, but the most frequent location is on the girl's undergarment posteriorly, or on the anterior portion of the undergarment of the accused. This holds equally for blood-stains. The presence of these stains may be explained in other ways than by an attempt to rape. However, when they are found on the clothing of the victim, it is, from a medical standpoint, at least, a strong indication that sexual intercourse has been attempted, though the evidence, for obvious reasons, loses much of its value when found on the accused. The spermatozöon, with other indications of rape, becomes a strong factor of importance; it strongly suggests, even if it does not prove, rape, and may go far to connect a man with an assault and attempt to ravish.

At times samples of clothing which have presumably been stained with blood are submitted for examination, and in such cases I would suggest testing the stain in the following manner:

If these are on some absorbent material, soak a bit of the cloth, as in the case of seminal stains, and place a drop or two of the fluid on a slide with a minute crystal of sodium chloride or potassium iodide. Then very gently evaporate to dryness under a cover-glass and allow a drop of acetic acid to run under the cover-slip. Afterward warm until bubbles arise, allow to cool, and examine for crystals of hæmin, which appear as yellow or chocolate-brown thrombic plates, often in rosettes and crosses. Should the stain be on a piece of glass or wood, scrape off a bit with the point of a knife, add a drop of water, and proceed as above. This is known as "Teichmann's" test, and I have procured similar results by placing the fabric in a normal salt solution

and then adding the acid, or by evaporating a drop of salt solution, placing the fragment in the centre, and then adding the acid. The test merely proves that the stain contains hæmoglobin, but does not inform us as to its being human blood. Care must be exercised in applying heat, as when too much is applied to the original drop the hæmin may be destroyed, and after the acid has been added overheating will drive the crystals to the edge of the cover-slip and they may be overlooked.

I have had no personal experience with the biologic test for blood, and when this test is to be made the clothing should be handed over to a competent serologist.

I am sorry to say that the importance of stains found to be present on the girl's clothing is not fully appreciated by the child's family. In little children it is of the greatest aid in the investigation to have these stains examined by an expert, and I have seen quite a number of convictions on this evidence alone. I always ask for the underdrawers or diaper which were worn at the time of the alleged assault, but, unfortunately, most often find that they have been destroyed or laundered.

Unfortunately, at least from the prosecutor's standpoint, some judges will not admit as testimony the finding of seminal stains on the clothing of the girl unless there is also found evidence of physical injury due to the attempted rape. The following case illustrates this point:

A little five-year-old girl was presented to me for examination with the statement from her mother that four days previous the child had come direct from the room of a male boarder, and when asked the trouble had said she was wet. The mother immediately examined the child and found her petticoat spotted with several stains, which were sticky and "smelt like semen." "The little girl told me that the boy had taken out his —— ('dirty word') and put it between her legs and she got wet." The boy, aged fifteen, admitted to me that the child had been in his room and that he had smacked her face, but had not tried to do her any other injury, "as he had been warned by another girl to guard his passions," although he admitted that he was an ardent masturbator. The examination of the child was negative, but the petticoat which was sent me by her physician showed that the stains were caused by semen. I was asked by the Judge if I had found any evidence on the child's body of an attempted rape, and my answer was, "not on her body, but that I had with me the child's petticoat." At this point the Judge exclaimed that he did not care about that and would listen to no such evidence. He again asked if anyone had been a witness to the alleged assault, and at this point the family physician tried to have the garment submitted as evidence, but met with little success. The boy was immediately discharged, though I may add that several times such evidence has been allowed and conviction followed.

(To be continued.)

Electrotherapeutics

A REVIEW OF THE MEDICAL APPLICATION OF RADIO-ACTIVE ELEMENTS

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RADIUM has received the most attention of the numerous radioactive elements now being so widely studied by competent observers throughout the scientific world. Thorium and uranium, although rather more feeble in their action, have been reported to have given good therapeutic results under favorable circumstances. The fact that all these elements are found in the same ores, rendering their separation difficult, makes the correlation of their individual worth in the treatment of disease at times not an easy matter, especially in those instances where the native mineral has been employed. At the same time it must not be forgotten that these minerals, probably, may contain a very small proportion of actinium, which, on account of its rarity, has offered very little chance for medical experimentation. Rubidium and potassium have also been found to be radioactive, but their activity is extremely feeble and is not likely to be of value.

In this country the literature upon this subject has been very meagre, compared with the vast amount presented by foreign writers. The reason for this is mainly due to the fact that we possess very little good radium, and, secondly, that those who have been interested in this field have not devoted themselves to it alone and are less enthusiastic as to the results obtained. Radium, like the Röntgen rays, requires the development of a given technic that cannot be acquired by a superficial knowledge of the subject. The individual peculiarities of the action of different specimens is abso-

lutely necessary. To know how and when to apply is only gained by experience. The properties of these elements are of such a subtle nature that in some instances deception has been practised and persons have paid enormous sums for practically worthless specimens. This deception has not alone been confined to radium, but to other radio-active substances as well. These facts have become recognized by the profession, and to a very great extent have discouraged the general masses as to the efficiency of these radio-active substances, even when applied under proper circumstances. It is most astonishing to see how many well-educated physicians have purchased a single specimen of radium, usually of poor quality, and applied it to a given case, expecting a marvellous result, only to be disappointed in its issue. If good results are to be obtained from this form of medication it must be given the same time and study as would be required in other fields.

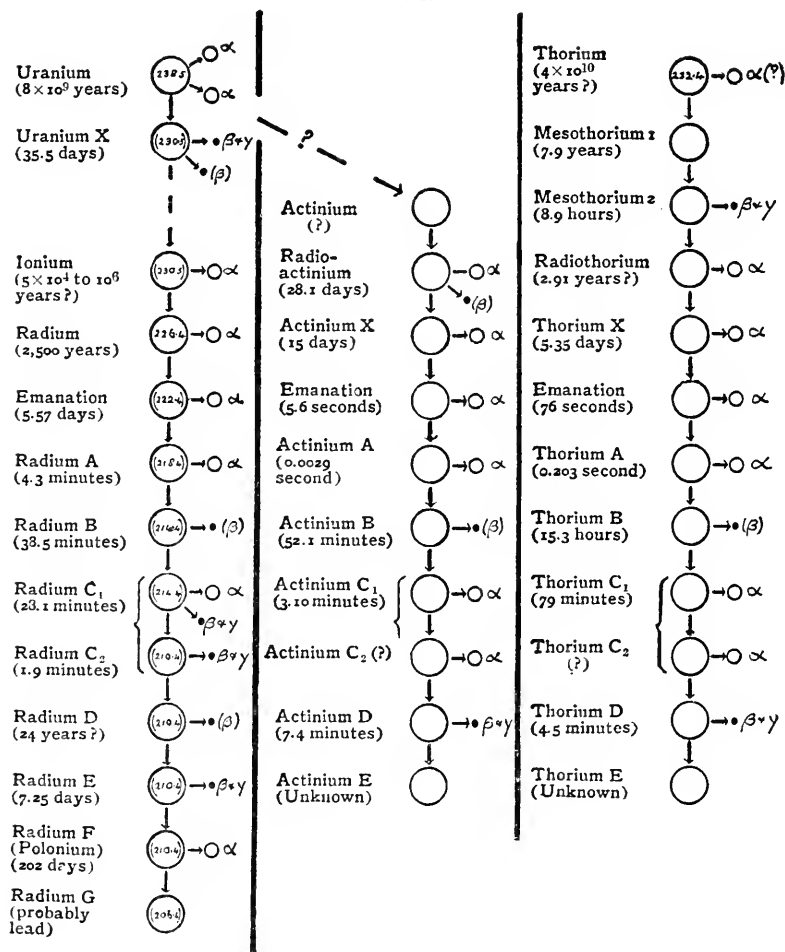
RADIO-ACTIVITY

The value of these radio-active substances depends upon the quality and quantity of rays given off by them. This property that they possess was first noticed in uranium by Becquerel; two years later the Curies and M. Schmidt, working independently of each other, noticed that thorium possessed the same property; but it was not until 1900, when Professor and Madame Curie gave to science their discovery of radium, that the real understanding of these rays was made possible. In fact, uranium, radium, and thorium are only weakly radio-active, but it is their disintegration into other substances, and these in turn into still others, that causes the emission of these various activities. In the course of this disintegration three distinct rays are eliminated, known as the α , β , and γ . It will be understood that, in considering these rays, radium will include the whole group of these disintegration products and simply be taken as a type.

The alpha particle, or α ray, is a particle of matter one-fourth the size of a hydrogen atom and discharged from one-tenth to one-twentieth the velocity of light; such rays are positively charged, feebly deflected by the magnet, and seem to form four more or less homogeneous groups, depending upon their source. These particles are shot off from radium much as projectiles are fired from

a gun; on account of their size they possess but a feeble power of penetration; they will pass through a thin sheet of aluminum foil, but a few sheets of ordinary paper or a few inches of air will

FIG. 1.



(From Soddy.)
Disintegration products of uranium, radium, actinium and thorium.

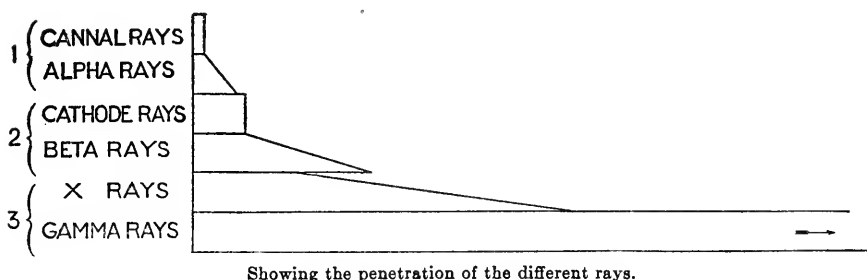
obstruct them. It has been estimated that a gramme of radium gives off 10,000 million alpha particles per second. (Fig. 1.)

The β ray is an electron or small particle charged with negative electricity, resembling somewhat the cathode ray of the Crookes tube and likewise strongly deviated by the magnet. Four thousand

beta particles would be required to balance one alpha particle. They are not homogeneous, and differ widely in their penetration; arbitrarily they are divided into soft, medium, and hard. These hard rays are of extreme tenuity, with a velocity of about 250,000 miles a second, and require the thickness of about 1 cm. of lead to arrest them. The quality of these rays depends largely upon the source from which they are derived.

The γ ray (gamma) are pulsations of the ether and are similar to hard X-rays; they are not deflected from their path by any agent, not even the magnet. They have a velocity equal to that of light. Their power of penetration is extreme, therefore it is very difficult to obstruct them, and they are practically only annihilated

FIG. 2.



Showing the penetration of the different rays.

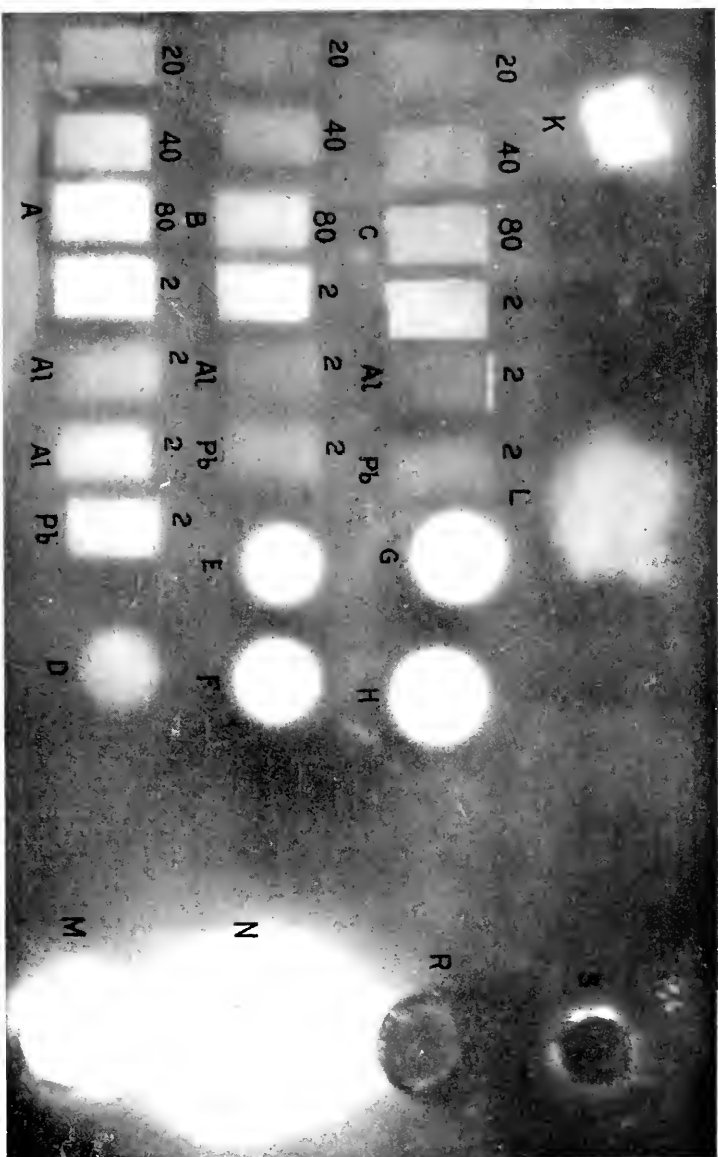
by space. Rutherford compares the penetrability of these rays as α 1, β 100, and γ 1000; and, while β rays are formed along the path of the γ ray, they no doubt are of very little therapeutic value. There is considerable difference in the proportion of the α , β , and γ rays given off by these radio-active elements, depending upon the age and the physical arrangement. For example, if a ten-milli-gramme specimen be in the form of a sphere, the α and soft β rays given off by those particles in the centre cannot escape; yet the hard β rays and γ ray emerge easily; on the other hand, if these specimens are spread out in a thin layer, then these soft rays find no resistance and no longer suffer occlusion, but escape freely. From a medical standpoint this is important, as the same rule holds here as in other fields; the soft rays are very active and may be used in superficial conditions, but where penetration is desired these soft rays must be removed, otherwise the superficial structures will suffer. (Fig. 2.)

MEASUREMENTS OF THE DIFFERENT RAYS AND STRENGTH OF
RADIO-ACTIVE SUBSTANCES

The most reliable method of ascertaining the strength of these elements is by the electroscope, which, however, requires skill in its use. When valuable specimens of radium are bought this measurement should be made by a trained physicist and the calculations made upon a basis of pure radium. The measurements so often given in the trade circles are misleading and decidedly inaccurate; the formula should read 35,671 milligrammes radium salt, containing 6,356 milligrammes radium, which is usually ascertained by the estimation of the gamma ray. By this method there is a distinct understanding as to the actual purity. The method of rating the activity upon the basis of uranium oxide as 1 and pure radium as 2,000,000 has been largely used, and for some purposes is valuable; but the adopted form in scientific circles is the Curie unit. Several rather crude methods have been suggested for measuring the strength of these elements, and may prove useful where an electroscope is not obtainable; they are, however, subject to considerable error. One is suggested by Abbe,¹ where a photographic plate is employed and a series of exposures made upon it, varying in time. They should be made upon the same plate, thus eliminating any error due to the difference of the emulsion or development. In this way a gradation of shadows is obtained and the strength of the radio-active elements made by comparison. The same method may be used where different thicknesses, as of metals, have been interposed, and the results of the different rays thus obtained. (Fig. 3.)

The luminance of the different fluorescent screens also serves as a guide to the relative strength of these radio-active substances; however, they differ in their effects, both as to the rays that impinge upon them and the fluorescent material that is used. The alpha ray causes a screen of zinc sulphide (sphalarite) to glow with marked brilliance, and is the basis of the spinthariscopes of Crookes, where, by using a rather weak specimen of radium and a magnifying glass, the individual pulses of each alpha ray can be distinctly seen as minute sparks that appear as the alpha particle impinges upon the small crystals of sphalarite; if these alpha rays are elim-

FIG. 3.



- Line A*—Radium in glass bottle, $1\frac{1}{2}$ inches from plate, 10 mg. 25 per cent. pure radium. Time, 20, 40, 80 seconds, and 2 minutes. Last part of series 2 minutes each with filters of alumina and a thin lead foil.
- Line B*—Radium in glass bottle, $1\frac{1}{2}$ inches from plate, 1 mg. 11 per cent. radium.
- Line C*—Radium in alumina container, $\frac{1}{16}$ mg. $1\frac{1}{2}$ inch from plate.
- D*—Container in direct contact with envelope of plate, mica cover in place. Radium, 4 mg. One minute.
- E*—Same, 2 minutes.
- F*—Same, 2 minutes, without mica cover.
- G*—Same, 4 minutes.
- H*—Same, 1 minutes without mica cover.
- I*—Five grammes pitchblende left in place for 12 hours.
- J*—Five grammes thorite left in place for 12 hours.
- M*—Container of lead, in which some radium chloride was split, washed and all recovered that was possible by a chemist.
- N*—The lid of the same.
- O*—The lid of another container, same size, accidentally screwed into *M*, but promptly removed.
- R*—The container fitting *S*, all exposed for 12 hours, showing the effects of minute quantities of radium.

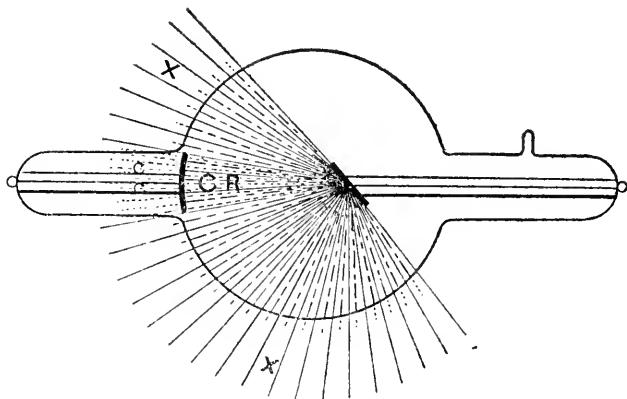
inated, a marked diminution in the fluorescence is noted. The screens that become most brilliant from the action of the other rays upon them are platinum-barium-cyanide, silicate of zinc (Willemite), or calcium tungstate (Scheelite).

By the use of the different forms of electroscopes the total α , β , or γ radiation is easily obtained; each instrument is so constructed as to eliminate the rays that are not desired.

RADIUM

Of all the radio-active substances, the salts of radium have been most commonly employed, in the form of the carbonate, sulphate,

FIG. 4.



C C, canal ray, analogous to the alpha ray. *C R*, cathode ray, analogous to the beta ray
X, X-ray analogous to the gamma ray.

chloride or bromide. The first two are insoluble in water, but the last two are somewhat deliquescent, and, where solutions are to be made, are to be preferred. Radium is obtained from pitchblende, where it is found in such minute quantities that its presence can only be determined by the electroscope, the richest ores yielding only a few milligrammes per ton. It is a by-product in the refining of uranium, and at present its chief source is from the mines of Austria; it is, however, found in all uranium-bearing minerals. It requires a long and tedious process for its separation, which is done by recrystallization with salts of barium, which chemically

is a prototype. Its atomic weight is 225, and when in a pure state it enters freely into combination with other elements. Heat is liberated spontaneously and will melt its own weight of ice per hour. Most of its salts are luminous in the dark. (Fig. 4.)

USE IN MEDICINE

From a medical standpoint these radio-active substances have been placed in about the same class as the X-ray; however, it must be understood that the rays given off by them are quite in a class of their own, while the analogues are to be found in both groups, yet the difference between them is quite marked.

Radium is used both as a local application or internally as a general medicine.

I. In its employment as a local agent it may be divided under the following heads:

1. (a) Direct exposure of naked radium salts.
(b) Protected by some material or contained in a capsule.
2. By using the emanation in solutions, pastes, ointments or incorporated in some inert power.

II. As a general medicine.

1. Radium salts in solution.
2. Emanation.

They may be administered by,

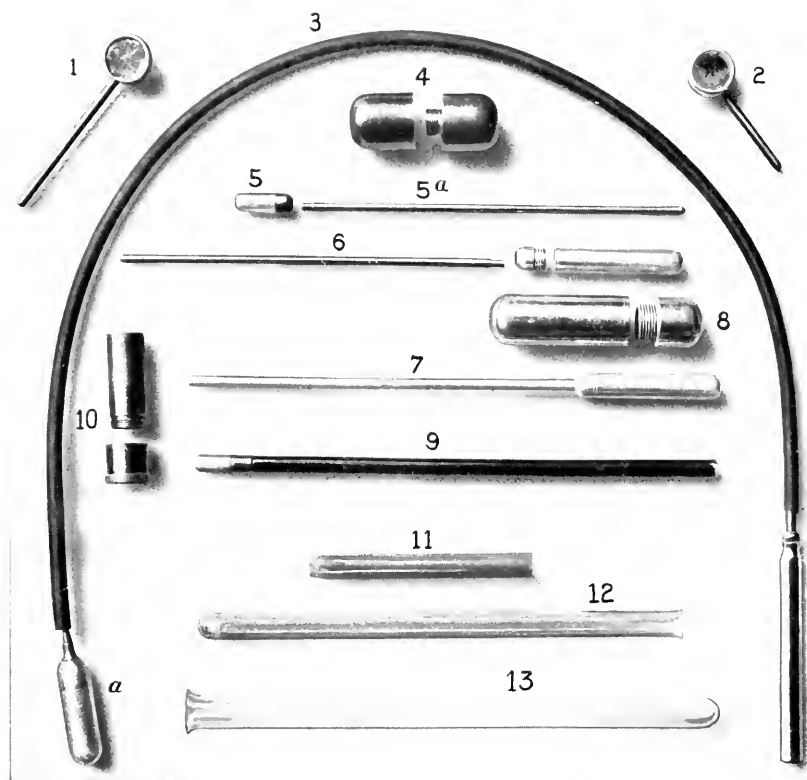
- (a) Mouth, rectum, or any of the natural passages.
- (b) Injections given hypodermatically or intravenous.
- (c) By inspiration of radio-active air.

LOCAL USE

(Applicators—Toiles—Radiodes)

Where radium is to be used for local applications it is mounted in some form of apparatus so as to preserve and conserve its waste: this piece of apparatus is usually known as an applicator, and, as the quality and quantity of the α , β , and γ radiations depend largely upon their construction, the following points must be considered. (Fig. 5.)

FIG. 5.



- 1-2. Applicators with mica covers that can be detached, containing about $\frac{1}{10}$ mg. pure radium.
3. Applicator for cavities, long enough to reach stomach; double alumina capsule, for grading filtration.
4. Lead case for applicator 5.
5. Applicator, alumina, small size.
6. Applicators, alumina, large size for protection and filtration, 4 mg. pure radium.
7. Alumina applicator containing 10 mg. pure radium, 25 per cent.; can be detached from handle and placed in case 12.
8. Lead case for applicator 6 or 7.
9. Alumina applicator mounted upon hard-rubber handle.
10. Lead case for applicator 9.
- 11-12. Celluloid covers, used for cover applicators.
13. Glass-cover applicator.

1. The activity of the salt of radium.
2. Weight of the salt and proportion of radium therein contained.
3. Impurities.
4. Surface and size of the grains of salt.
5. Distribution.
6. Age of salt.
7. The quality and quantity of the fixative substance or wall of a capsule.

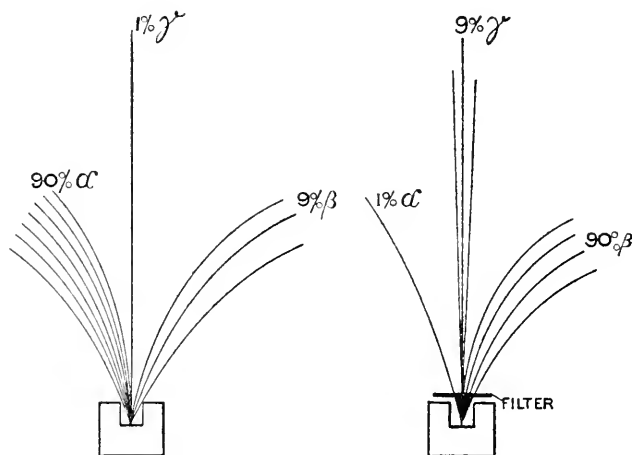
Where it is desired to use the alpha rays, the naked salt of radium must be employed. Under these circumstances it is usually placed in a small disk of metal or hard rubber, and great care must be observed not to spill or upset the contents; as a rule, this method is impracticable on account of losing small portions of it and the difficulty of application. By fixing the radium salt upon the applicator with varnish or similar substance, a few of these α rays and the soft β rays are lost, but still many of them may be employed.

Where a greater surface is desired, radium salt may be incorporated in a piece of silk or wool. These flexible materials serve another purpose: they conform easily to irregular surfaces, but must be handled with great care, as they become exceedingly brittle. The name of "Toile" applicators has been given to them by Wickham.² Clothing, bandages, and other such articles have been "radiumized" and used when extensive surfaces are to be covered. As all the soluble radium salts are more or less deliquescent, it is necessary to use some form of varnish to cover these fine particles and protect them from moisture as well as dust. Even with this thin coating of varnish there is a marked lowering in the proportion of the rays. This is well illustrated by the experiment of M. Razet, where he first tested a specimen of naked radium and found that it gave off 90 per cent. α rays, 9 per cent. β rays, and 1 per cent. γ rays. When this same specimen was mounted in varnish the proportion was α rays 1 per cent., β 90 per cent., and γ rays 9 per cent. (Fig. 6.)

Under ordinary circumstances these very low rays are not desirable; their surface activity is only suited to very superficial conditions, and when the rays are required to penetrate below the surface of the integument the preponderance of these low rays

causes too much superficial reaction, without reaching the depths. As most cases which come under treatment require some degree of penetration, the removing of these very soft rays is to be desired. For general use, placing the radium within a tube of thin glass or alumina gives it better protection and practically filters out these undesirable rays; under some conditions, where the growth is very deep, additional filters of leather, alumina, silver, lead, gold, and platinum are found useful. When using strong specimens of radio-

FIG. 6.



Showing the difference in proportion of the α , β , and γ rays, with and without filter. By increasing the thickness of the filter the proportion of gamma rays becomes greater, the alpha rays are finally cut off, and the softer beta rays next, until the filter is increased to 1 cm. of lead, where all the β rays are practically cut off. There are, however, other β rays formed, these, however, being secondary. (Diagrammatic sketch modified from Razet.)

active salts it is not advisable to have them in too close contact with the skin, and some authors advise the use of small lead cones, the salt being placed in the apex, and the base upon the surface to be treated, the distance between usually being an inch or two. It must be remembered that the lead also becomes radio-active under these conditions and gives off a secondary radiation, and for the protection of surrounding tissues from the radiation of the lead it is usual to employ them guarded by several layers of paper, thin rubber, or mica. These protected lead covers have been given the name of "caché" by M. Sagnac.

A very practical container is made of alumina, in which the

radium salt, or small bottle containing it, can be placed; its shape may be varied according to the ideas of the operator, and it may be mounted upon some convenient handles of metal or hard rubber, for various purposes of application. The late Dr. Shober gave the name "radiode" to this form of applicator. Special forms of applicator handles for use in cavities, the stomach, bowel, uterus, etc., are made of metal or hard rubber, which permit thorough cleansing and sterilization; however, a far better method, when using these radiodes in cavities, is to protect them with small covers made of celluloid that may be burnt immediately after each application. They afford protection both to the patient and the radium.

Where the radium salt is confined within a sealed container, especially of thin glass, it should always be handled with care, and always over something like a glazed paper. The fact that there is continually an elimination of gas from these salts, and that from this or some other cause, such as dropping them, explosions have occurred, makes it necessary to be very guarded to prevent a consequent loss of radium.

DOSAGE

While at present no standard of dosage has been established, there are, however, several methods in common usage that serve as a matter of record and to a great extent tend to give us a tangible idea, within distinct limitations, of the actual amount of radiation a given person receives. The difficulty in arriving at an exact conclusion in this matter is due to the variable quantity of the three rays received, under many different circumstances.

It has been suggested by Turner of Edinburgh to give the amount of radiation in the same manner as is employed in denoting the flow of electricity, as the ampère-hour; in other words, a ten-milligramme specimen of pure radium applied for one hour would be called ten milligramme-hours, and corrections made according to the time and strength of the radium. If, for instance, a 1,000,000 unit, five-milligramme salt of radium be applied for one hour, the total would be two and one-half milligramme-hours. It can be seen, however, that there is considerable weakness in this idea, and that it only vaguely expresses the amount of radiation received by the individual.

Kilouranium, or kilurane, has been suggested by M. Beaudoin, each unit representing 1000 uranium units; in these terms there seems to be little value, as they simply express the radiation upon the basis of the uranium unit, without regard to the different forms of radiation. One that has been widely used is the "maché" unit,³ which is somewhat more accurate, as it represents the energy in volt-hours multiplied by 1000. Many German writers give about the same standard, expressed as "electrostatic units." The measurement by such scales as Holtzknecht, Sabourand, or Keinboch cannot be used on account of different rays acting upon them in different values, according to the nature of the salts and their fixtures.

Aside from the standards of dosage, authorities fail to agree upon the amount of radiation to be given under similar circumstances. As a class they may be divided into two groups: those who believe in giving one or two treatments strong enough to accomplish the result, while the others believe in comparatively weak, individual treatments repeated a number of times. It would seem that the middle course is by far the safest and less liable to complications. Where one or two strong treatments are given, severe burns may follow, due to some personal equation that cannot be reckoned; where many weak treatments are administered, the disease is given time to make inroads upon the tissue that might be otherwise spared.⁴

Each individual applicator must be studied and the dosage calculated accordingly. While a low-grade radium loses a higher ratio of its alpha and low beta rays than a high-grade radium, due to the occlusion of these rays within its own mass, the mass being impure, it is, however, suitable for superficial diseases and can be spread over a considerable surface; its usefulness, for instance, in the treatment of patches of eczema cannot be denied. On the other hand, where we have a malignant process, such as a carcinoma or sarcoma, the demand is for a specimen of radium sufficient to cause quick and marked reaction, after being well filtered of the low rays that cause only a superficial disturbance with no depth; and the fact of losing sight of these two points does more harm than the process of disease left to its own course. It should be remembered that weak radiation is to a great degree stimulating; this

favors cell multiplication and does not retard. If, on the other hand, the specimen is not well filtered, the low rays cause superficial ulceration without sufficient reaction in the deep structures to cause a retardation of the growth, and here we add ulceration upon the surface, with possible stimulation to the deep structures. Therefore, in treating deep disease, a good specimen of radium must be employed and well filtered. As a matter of record, the amount of radiation should be kept, the place of application, the distance between the parts, the proportion of pure radium in radium salts, the manner in which the salt is mounted, style of filter used, the proportion of the several rays, and time of application.

TECHNIC OF APPLICATION

It is needless to state that the method of application must be varied with the character of disease to be treated. For instance, if the condition is one of a widespread, superficial nature, one of the silk or cloth "toiles" may be employed, as the radium salt under this condition is usually of weak nature. The reaction is no doubt caused by the alpha and weak beta rays; this, therefore, requires the material to be in contact with the skin for a long time, and, consequently, it must be protected from moist surfaces. This method of application is suitable for the treatment of certain forms of chronic eczema, and also the eczemas of young children. For other forms of eczema and allied diseases better results are obtained by employing the radium in a small capsule and moving the position over the area every few minutes. Where the radium is to be employed in the treatment of malignant diseases it should be of sufficient strength to cause reaction after a few applications. On account of the idiosyncrasies of some individuals it is always a good rule to begin with short applications made a few days apart, and gradually increase the length until the desired result is obtained. When applying radium for the treatment of deep-seated conditions care must be taken not to cause degeneration of the overlying structures. This may be avoided: first, by the use of filters; second, sufficient space between applicator and surface skin; and, third, as Wickham has recommended, the site of application should be frequently changed, arranging what he has styled a "cross-fire." By this means the rays are brought upon a mass at a given depth from

several different directions. Under ordinary circumstances reaction is not so rapid upon the mucous membrane as upon the skin, no doubt due to the moisture and blood supply of the mucous surfaces; therefore, when such applications are to be made to these moist parts, they should be kept as dry as possible.

Where it is desired, the radium capsule may be implanted in a growth or tumor and left imbedded there for a few hours each day, depending upon conditions. In most instances where this has been tried the radium has not been of sufficient quantity or quality to give good results. Under general conditions it is impossible to give the exact time and manner of application for the various diseases. This problem must be studied by the operator according to the strength of his preparations and the requirements of each individual case. This will often tax his ingenuity to the utmost, but it is upon this point that some have succeeded where many have failed.

LOCAL USE OF OTHER RADIO-ACTIVE SUBSTANCES

While the radiation from uranium is extremely feeble, its salts and natural mineral products have been used with success in the treatment of some cases such as lupus and small epitheliomata. It may be questioned, however, where these uranium principals have been employed, if the effects were actually due to the element itself, or to some of the impurities which it contained. As has been previously mentioned, all these radio-active elements are found, to a greater or less extent, combined in the same ores, and it is not unlikely that some of the therapeutic effects were due to impurities; this, however, is *sub judice*. Where the native mineral has been employed it was applied directly to the diseased part for a number of hours each day, and these applications were continued until normal conditions were restored. The salts of uranium have also been mixed with various bases to form ointments and applied. In some instances the radio-active portion of the uranium was removed by precipitation of an iron base in a solution of uranium, and the iron precipitate applied in the form of a paste; these methods, however, have not met with general favor, and their use has been limited.

The same applies to the mineral products of thorium; however, since the active portion of thorium has been successfully separated in the form of mesothorium, thorium X, and radio-thorium, there is a likelihood of this element becoming a close rival of radium. By some it is supposed to be superior for treatment under certain circumstances. Its mode of application is similar to that described, a few milligrammes being used in a metal container. As there is a decided difference in time between the interchange of these respective elements, their use must be governed accordingly; other-

FIG. 7.

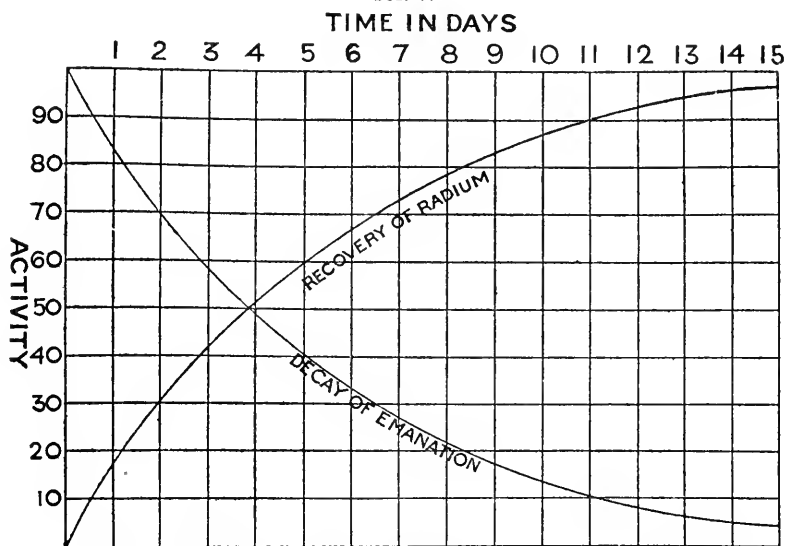


Diagram representing the decay of emanation and the recovery of radium.

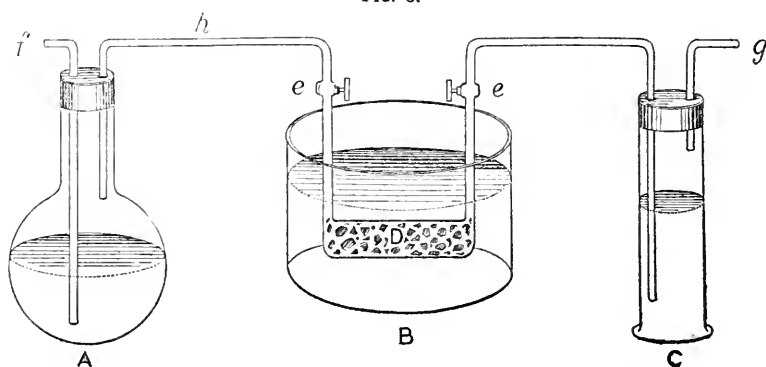
wise, specimens that have not been properly aged will be lacking in strength. (Tsiurdis,⁵ Pinkus,⁶ Metzner,⁷ Schwarz and Zehner,⁸ and others.)

THE EMANATIONS

Radium is constantly undergoing degeneration to the next lower element, this being the emanation. It is a gas, exceedingly dense, in the pure state conforming to all the laws of other gases; being obtained in such meagre quantities, it is well diluted. It is readily absorbed by water, glycerine, charcoal, and other inert substances; in this way it is possible to charge them and thus render them radio-active. They may be employed the same as the radium salts,

and in this way one may obtain a fair amount of radiation. It must be remembered that these preparations undergo a rapid decay, must always be freshly prepared, and, where possible, always tested immediately before using. The life of the radium emanation is about thirty days. The maximum activity is observed a few hours after its abstraction, but one-half its strength is lost in four days; while, on the other hand, the decay of the thorium emanation is a matter of seconds, and actinium is still more rapid; this fact renders it useless in medicine. (Fig. 7.) The time required for the recovery of

Fig. 8.



Apparatus for collecting the emanation. A given quantity of radium salt is dissolved in water slightly acidulated in flask A. Pure air is then drawn through the solution by pump attached to tube *f*. The air entering *f* passes out through *h*, charged with the emanation, and may be collected in *D* if *B* contains liquid air, which causes the emanation to condense. If the tube *D* contains a few broken pieces of willemite (zinc silicate), the presence of the emanation causes it to emit a brilliant glow. After all the emanation has been abstracted from the radium the stop cocks *e e* may be closed until it is desired to use the emanation. Water, glycerine, charcoal, or other substances may be charged in *C*.

the radium salt after the emanation has been abstracted is practically in a reverse curve to the rate of decay. The emanation is obtained from radium by dissolving the salt in water which has been slightly acidulated, and then allowing a stream of air to pass through the solution, when it becomes charged with the gas. If it is desired to collect it, a small tube which contains a minute fragment of willemite is placed in liquid air; the cold produced causes the emanation to be condensed upon the surface of the willemite, and a brilliant fluorescence is noticed. (Fig. 8.) The tube may then be sealed or the charged air may be passed through a tube containing charcoal or some other substance which readily absorbs it. The emanation is desired where the low rays are to be employed and can

be used locally; as an application in various forms, internally in solution, or it may be inhaled in air charged with it. (Von den Velden⁹ and Kionka.¹⁰)

USE OF RADIO-ACTIVITY IN GENERAL MEDICINE, BATHS AND EMANATORIUMS *

The use of radio-activity, internally, in general medicine has been more or less confined to those portions of the world which have been fortunate enough to possess radio-active springs. England, Central Europe, and Japan possess well-equipped emanatoriums, where the patient receives these waters as medicine, baths, or may inspire air charged with the emanations. While these waters are extremely feeble in their activity, some remarkable results have been reported, which no doubt are often due to the care and exactness of a given régime. In Bath, England, the King's Well has been reported to contain 1.73 milligrammes radium per million litres, with large quantities of nitron and helium, supposedly due to the degeneration of radium.

In Austria the wells at Joachimsthaler have a relatively high radio-activity, and are used in the treatment of various conditions, such as rheumatism, neuritis, effects of nerve and arterial changes, and gastric catarrh. These wells differ in strength, from 33 to 49.5 maché units to 623 to 1200 maché units, and at times the activity is raised to 18,000 or over 60,000 units, depending upon the needs of the individual.

The person is immersed and kept quiet from 15 to 45 minutes; temperature is varied according to the comfort of the patient. With this the person usually drinks, four or five times a day, a litre of water of about 600 units. Central Europe, including Austria, Italy, Switzerland, France, and Germany, possesses a number of these natural radio-active springs, and in some places claims are made upon the addition of their thermal qualities or the fact that they are charged with gas. In other spas not so fortunate as to possess such springs, water has been made radio-active by dissolving small portions of these radio-active salts or charging it with the emanation.

* Engler,¹¹ Ramsey,¹² Schaefer and Seeborn,¹³ Barcot,¹⁴ Lachmann,¹⁵ and Kisch.¹⁶

A number of the springs in America, such as those of the Hot Springs, Va., contain radium, according to recent U. S. Government reports.

PHYSIOLOGIC ACTION *

The local action of these radio-active substances depends upon two factors, the first being the personal equation of the individual, the condition and nature of the local tissues, and extent of surface exposed; and, second, on the part of the radio-active principal, which is modified by its strength, distance from the surface, time of exposure, and amount of filtration. The most important factor to be considered is the one of personal equation, and to illustrate the susceptibility of some individuals Friedländer reports a case of chronic thorium dermatitis occurring in a workman in the manufacture of gas mantles. In this instance the disturbances of the skin were the same as have been observed in X-ray dermatitis.

The word "reaction" has been adopted by usage for the local effect of radiation upon tissue, and, while it does not imply any definite degree, yet it signifies a definite change in the tissue elements. It need not be accompanied by inflammation or destruction to be of benefit; yet at times such reaction is of value; it is always in proportion to the amount of dosage and the resistive power of the tissues. General symptoms from the local use of these elements depend largely upon the part of the body exposed, the extent and amount of damage to the tissue, causing an absorption of products that must be eliminated.

The effect of these radio-active elements, all things being equal, is somewhat the same as that observed from the X-ray. In small amounts it may be stimulating, passing rapidly into inhibition, which may vary in a wide degree. The length of time that it is observed varies from a few hours after the application to weeks and even months. At first a slight redness over the site may be noticed; this may pass to the stage of vesication, to be followed by ulceration. This process may subside at any stage and gradual repair follow. The secondary effects that are then observed depend upon the severity of the first stage; if slight, only a faint pigmentation; while in the more severe types pigmentation, scarring, and the typical telangiectasis, commonly seen in X-ray burns, may be noted. The deeper effects depend upon the part to which the application

* Engelmann,¹⁷ Friedländer,¹⁸ Smith,¹⁹ Mesernitzky,²⁰ Newberg and Karezag,²¹ Domarus and Salle.²²

is made; the process is practically the same and usually ends in atrophy.

There is not the least doubt that there is a distinct difference between the radio-active elements in their physiologic action when given internally, but as a group they may be compared to powerful alteratives; their effects are noted upon all the tissues of the body, which to a great measure is influenced by their mode of entrance and elimination, and, when the salts are used, depend largely upon their solubility. These points are well expressed by the conclusions of Smith:

1. That after the administration of radium by mouth or by injections a widespread degree of radio-activity is evident throughout the body.

2. That elimination of radium takes place principally and rapidly by the bowel, in a minor and slower degree by the kidney, while in mice, at all events, there is no evidence that the liver or skin plays any part in excretion. As regards the elimination of the element by the bowels, it is certainly excreted by the small intestines, and there are indications that the large bowel also assists in that function.

3. That the high activity in the lungs is possibly due to the extreme vascularity of these organs, but its constant presence at all times after inoculation and the fact that the emanation is entirely eliminated by the lungs suggest that an accumulation of radium takes place with a view to the more ready excretion of the emanations.

4. That the emanation can be obtained in solution in various media and can be introduced into the body in small doses by inhalation, feeding, or by injection.

5. That after such administration, and however introduced, a general radio-activity of very brief duration is caused throughout the body.

6. The elimination of the emanation takes place principally, and almost entirely, by the lungs, and to a very slight extent by the kidneys.

7. That the duration of the activity induced in the body, or, in other words, the time taken by excretion, differs with regard to the nature of the preparation used. Soluble salts of radium are rapidly eliminated, however administered. The insoluble salts per

os are excreted directly by the bowel, and there is no evidence of any temporary absorption and circulation. When given by injection, however, an exceedingly slow elimination takes place by the bowel. The time taken, however, is so great that, for all intents and purposes, the salt may be considered to be permanently present at the site of injection.

8. The elimination of the emanation occurs with great rapidity, and was complete after administration in powerful doses in so short a time as four hours.

The influence upon the system is extreme: changes have been observed in the purine products, urinary secretions, with more or less change in the blood picture, often attended with a marked lowering of the arterial pressure. If the administration be continued or if large doses are given, fatty degeneration of such organs as the liver and kidney, with still greater changes in the blood, are likely to follow; therefore, caution at all times should be observed to guard against a fatal issue.

There has been some attempt to connect the endemic development of goitre with the radio-activity of the neighboring water supply, but so far this theory has not been proven. In a general sense the effect is inhibitory, which has been proven by observations upon fish roe and fertile eggs.

DISEASES TREATED BY RADIO-ACTIVE APPLICATION

Acne.—Good results may be anticipated by the local use of these elements in the various forms of acne—those especially where there has been deep scarring and an overgrowth of fibrous tissue. The amount of radiation must not be too severe.

Eczema.—The chronic forms that have failed to respond to other forms of treatment are often relieved in a short time—even those types in young children that are often rebellious to most soothing ointments.

Psoriasis, in its various forms, has yielded to the local use; the difficulty in these cases is the widespread distribution of the disease.

Diseases of the Hair.—Sycosis, favus, etc. As in the use of the X-ray, the result depends upon the temporary depilatory action,

but when radium is employed the loss of hair seems to be of greater duration, and for this reason it has given favorable results in hairy nævi.

Nævi.—Various forms of angiomata and pigmented conditions of the skin may be successfully treated, but considerable skill is needed in making these applications, the difficulty being in obtaining the proper amount of destruction of the tissue so as to accurately match the surrounding surfaces. Warts and papillomata usually yield easily, and even polypi occurring in the nose, throat, and larynx have been successfully treated.

Keloids and cicatrices may be absorbed; the results in these troublesome conditions are at times remarkable, such as the report of a case of stenosis of the trachea. (Kantas.²⁵) Keratosis, in its various forms, ichthyosis, and various forms of lichen, chloasma, and other diseases of kindred nature, have been successfully treated by a number of different authors. In indolent syphilitic gumma radium may be used to assist other forms of treatment.

Lupus vulgaris yields easily, but care must be taken not to give too active radiation; in those cases where ulceration has not produced a great amount of tissue destruction, very little scarring is to be observed. In lupus erythematosus a somewhat deeper radiation is desired, and it is therefore advisable to use a thin filter, while in the former diseases filtration is not so necessary. The results observed here are also good. Other tuberculous processes occurring in the mucous membrane and in the lymph-glands have also been treated, the technic depending upon the position of the ulceration or mass.

It has been employed in mycosis fungoides, idiopathic hæmorrhagic sarcoma of Koposi, and sarcoma generally, with good results, if the disease has not been too disseminated.

The use of radium in the treatment of malignancy is most interesting. While it is by no means a panacea, it offers a hope in those cases that are beyond relief from other methods. In the report of the Radium Institute in England, Pinch states that in selecting cases for treatment, except in rodent ulcer, no case was treated that was suitable for operation. In a list of 147 cases of squamous-celled epithelioma of various parts, such as the mouth, vulva, uterus, and penis, 7 were apparently cured and 39 improved. Considering

the condition of these patients and the usual character of the disease in this form, the results are remarkable. He also reports a series of 101 cases of rodent ulcer with 31 apparently cured and 41 improved, which is far more promising, although it must be realized that this disease is much more indolent in its course than those of the first series.

In making the application of radium it should be brought in as close contact as possible with the diseased process, and great caution should be observed to prevent its effect upon surrounding sound tissues, which are most needed to aid in repair and the final restoration of the parts to normal conditions. In those instances where metastasis has extended into the surrounding glandular structures the X-ray is to be preferred on account of the extensive surface. It must be remembered, however, that often disease that fails to respond to one will yield to the other.

In leucoplakia the results are especially good; advanced cases often yield from the effects of a few applications, and in this instance the results are as gratifying as in surface epitheliomas. When the disease has been healed it is surprising to see the little amount of scarring that is left at the site of disease. Several instances of epithelioma of the face have been noted when there had been a previous operation for the removal of the disease at the site of ulceration, and upon healing the former scar and stitch marks were as evident as they were before the secondary process began. Uterine fibroids have been greatly reduced in size and the hemorrhage incident thereto controlled. Metritis of the chronic catarrhal type has apparently yielded to applications of radio-active substances.

In exophthalmic goitre the thyroid gland has been greatly reduced in size with the general improvement of symptoms. Relief from pain and restoration of functions have been afforded in various forms of arthritis by absorption of the local exudate of the affected parts, even in those from cases of gonorrhœal origin. Application over neuralgic areas has given relief from the pain, and in neuritis and sciatica the same analgesic effect has been noticed. In some instances where the disease of the nervous system is due to spinal degeneration the trophic changes incident thereto have been greatly altered when radio-active salts have been employed.

DISEASES TREATED BY INTERNAL ADMINISTRATION

The technic used in the internal administration of these radioactive principles is more or less complicated, and the best condition for their use is to be found in a well-equipped emanatorium. Encouraging reports have been published in cases of simple, chronic arthritis, chronic muscular rheumatism, progressive polyarthritis, infantile arthritis, gonorrhœal monoarthritis and polyarthritis, and cases of gout before there have been great changes about the joints. Gudzent believes that the acute and subacute forms of gonorrhœal and specific arthritis, as well as those cases associated with erythema or purpura, should be excluded from the list for treatment.

Some interesting notes have been recorded by Plesch, Nagelschmidt, Bickel, and others where this method of treatment has been used in pernicious anæmia, anæmia megalosplenica infantum, and myelogenia of leukæmia; in most of them there was a decided improvement of the blood and in general conditions also, such as appetite, tone of the heart, and even in those cases where kidney disease was present it in no way interfered.

RÉSUMÉ OF THE FIELD

There is not the least doubt that advancement in any field of activity depends upon those who are enthusiastic enough over the subject to give to it their time and best effort. In many instances this leads to a decided bias of opinion, which in time often gives rise to an error of judgment. From this cause exaggerated reports, made prematurely, have produced in the mind of the profession and laity a confused idea in regard to radium therapy, which has also been enhanced by its frequent and unjustified use as a placebo.

The use of radium should be confined to those conditions of disease that cannot be combated with other forms of treatment, and there are but few exceptions to this rule. Cases referred for treatment should be carefully selected, for it must be realized that, as with all other remedies, there are dangers which must be carefully avoided.

BIBLIOGRAPHY

- ¹ Abbe, Robt.: *Med. Record*, Oct. 12, 1907.
- ² Wickham tran. Doré: "Radiumtherapy," New York.
- ³ P. Oudin et Zimmern: "Radiotherapie," Paris.
- ⁴ Bayet. übert Schiff: "Das Radium," Wien.
- ⁵ Tsiurdis, A.: "Ueber die Kreislaufwirkung des Thorium X nach seiner intravenösen Injektion beim Kaninchen" (*Pflügers Archiv für die gesamte Physiologie*, Bd. 148, 1912, S. 264).
- ⁶ Pinkuss, A.: "Zur Behandlung des inoperablen Karzinoms mit Mesothorium und kombinierten Behandlungsmethoden" (*Deutsche med. Woch.*, 1912, S. 1777).
- ⁷ Metzner, W., und Cammerer, J. B.: "Zur Messung von Thorium X-Präparaten" (*Berl. klin. Woch.*, 1912, S. 1789).
- ⁸ Schwarz u. Zehner: "Ueber einige chemische Strahlungsreaktion Versuche mit Thorium" (*Dtsch. med. Woch.*, No. 38, 1912).
- ⁹ von den Velden, R.: "Zur Wirkung der Radiumemanation auf das Blut" (*Deutsches Archiv für klin. Medizin*, Bd. 108, S. 377).
- ¹⁰ Kionka, H.: "Die Behandlung mit Radioemanation" (*Dtsch. med. Woch.*, No. 24, 1912).
- ¹¹ Engler: "Ueber die Entstehung radioaktiver Quellen" ("Radium in Biologie und Heilkunde," Bd. ii, H. 4, S. 123).
- ¹² Ramsey, W.: *Chem. News*, cv, p. 133, Mar. 22, 1912.
- ¹³ Schaefer u. Seeborn: "Die Radioaktivität des Bades Pyrmont" ("Radium in Biologie u. Heilkunde," Bd. ii, H. 4, S. 116).
- ¹⁴ Barcat, J.: "Precis de Radiumtherapie" ("Radium in Biologie und Heilkunde," Bd. ii, H. 3).
- ¹⁵ Lachmann: "Statistische Betrachtungen über den Einfluß der durch die Entdeckung der Radioaktivität gewonnenen neuen Indikationen auf die Frequenz des Bades Landeck i. Schl." (*Zeitschrift f. Balneologie*, 1912, S. 280).
- ¹⁶ Kisch, E. H.: "Die Radioaktivität in der Balneologie" ("Radium in Biologie und Heilkunde," Bd. ii, H. 3).
- ¹⁷ Engelmann, W.: "Ueber den Emanationsgehalt des Blutes nach Trinken von Emanationswasser" (*Berl. klin. Woch.*, 1912, S. 1036).
- ¹⁸ Friedländer, W.: "Ueber chronische Thoriumdermatitis" (*Arch. f. Derm. u. Syph.*, Bl. 113, S. 359).
- ¹⁹ Smith E. Bellingham: *Quart. Jour. of Med.*, 1912, p. 249.
- ²⁰ Mesernitzky: "Die Zersetzung von Oxypurinen durch Radiumemanation" (*Zeit. Bl. f. inner. Med.*, 1912, p. 573).
- ²¹ Newberg u. Karezag: "Ueber das Verhalten von Lecithin gegenüber Radiumemanation und Thorium X" ("Radium in Biologie u. Heilkunde," Bd. ii, H. 4, S. 116).
- ²² Domarus, A. v., und Salle, V.: "Ueber die Wirkung des Thorium X auf die Blutgerinnung" (*Berliner klin. Woch.*, 1912, S. 2038).
- ²³ Hockendorf: Ueber die Ausscheidung parenteral zugeführter Harnsäure beim Hunde unter dem Einflusse von Radium ("Radium in Biologie und Heilkunde," Bd. ii, H. 2, S. 50).
- ²⁴ Brill u. Zehner: Ueber die Wirkungen von Injektionen löslicher Radiumsalz auf das Blutbild (*Berl. klin. Woch.*, p. 1261, 1912).

²⁵ Hertwig, C.: "Das mit Radium bestrahlten Spermachromatins im Seeigel" ("Radium in Biologie und Heilkunde," Bd. ii, H. 4, S. 132).

²⁶ Albanus: "Die Methodik der Radiumbestrahlung in der Nasen-, Mund-, Rachenhöhle, im Kehlkopf, in der Luftrohre und im Schlund" ("Radium in Biologie und Heilkunde," Bd. ii, H. 1, S. 29).

²⁷ Kantas, of Athens: "Ueber die Radiumtherapie bei Trachealstenosen" (*Wiener medizinische Wochenschrift*, 1912, S. 1190).

²⁸ Report of Radium Institute (*Brit. Med. Jour.*, Jan. 25, 1913).

²⁹ Buchsbaum, B.: "Zur Therapie von Neuralgien mit Radium" ("Radium in Biologie und Heilkunde," Bd. ii, H. 1, S. 27).

³⁰ Prado-Tagle, E.: "Zur Kenntnis der durch Radiothorium erzeugten Gewebsveränderungen" (*Berliner klin. Woch.*, 1912, S. 155).

³¹ Nagelschmidt: "Ueber Thoriumbehandlung der Leukämie" (*Deut. med. Woch.*, 1912, S. 1830).

³² Plesch, J.: "Fälle von perniziöser Anämie und Leukämie mit Thorium X behandelt" (*Berl. k. Wochenschr.*, Dec. 2, 1912).

³³ Bickel: "Beitrag zur Thorium X-Behandlung des perniziösen Anämie" (*Berl. k. Woch.*, 1912, p. 9322).

³⁴ Klecki, C. v.: "Ueber den Einfluß der Radiumemanation auf die Phagozytose von Bakterien" ("Radium in Biologie und Heilkunde," Bd. ii, H. 3, S. 99).

³⁵ Gottlieb: *Arch für phys. Med. u. Med. Tech.*, vol. vii, No. 2.

³⁶ Orth and Bickel: *Brit. Med. Jour.*, July 20, 1912.

INTRODUCTION TO ELECTRICITY, ELECTROPHYSIOLOGY, AND ELECTROTHERAPEUTICS

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WHEN the old Greek philosopher, Thales, 600 years B.C., rubbed his stick of amber and discovered that it would attract some light bodies and repel others, the world became the possessor of a secret which, it seems, had been hidden from the ages before his time. While no one has been able satisfactorily to define the "what is it?" that we call electricity, we have learned from experiences past and present that it exists in all matter, both animate and inanimate, and may be called into action by any process that will disturb the molecular equilibrium of matter. Thus to friction do we owe our *first* knowledge of this wonderful agent, though it may also be produced by percussion, heat, compression, chemical action, and (what, as physicians, should concern us especially) by every physiological action, every anabolic and catabolic change, that takes place in the body.

It seems that for about 2300 years, or from 600 B.C. to 1786 A.D., the world was familiar with frictional or static electricity only. At about the latter date Galvani gave to the world the results of his experiments upon frogs' legs, and claimed the discovery of animal electricity. Volta, to prove his own contention that the (animal) electricity of Galvani was due to contact of moist tissue with dissimilar metals, constructed his voltaic pile. Thus, simultaneously almost, was the fact of animal electricity, or physiological electricity and electricity due to chemical action, made manifest to the sleeping world. Hence we see that physical friction produced by disturbances of the molecular equilibrium in the rubbed amber, and also in the substance with which it was rubbed, gave to the world static electricity, and all that has been learned since that time of static electricity is based upon a knowledge of the principle involved in the above process. To the (mental) friction of two great minds, Gal-

vani's and Volta's, are we indebted for three very important facts: First, that electricity as such *does* exist in the tissues of the body, and is brought into action by any and every physiological or pathological process that will disturb molecular equilibrium; for instance, a nerve impulse, muscular contraction, or any of the many functions of the body cells. Second, that chemical action between two dissimilar metals, acting through an electrolyte, will produce a continuous current. Third, that the current so produced has all the physical properties of the currents found in the animal body. The latter seems to be associated in some important way with all the body functions. There is no longer any doubt that these currents of the body exist and are measurable; even the emotions have been measured in milliampères. It has been clearly proved that the strength of the tissue currents is directly proportional to the vitality of the tissues. This important subject will receive further consideration in another place.

The discovery of Michael Faraday, in 1831, that currents can be induced in closed circuits by moving magnets has gradually led to the evolution of much of the machinery that is being used to-day for the production of the currents of commerce, both direct and alternating, as well as the electromedical coils known as induction coils and faradaic batteries. From the three sources named do we derive all the currents of electricity used in electrotherapeutics and all the modifications of currents,—all of them differing widely in their physical properties and in their physiological effects, but all obeying certain fixed laws for their absolute direction and control. How these various batteries and sources of currents gradually evolved from their primitive states is merely a matter of history, and, though interesting, is not of sufficient importance for time or space here.

Faraday claimed that *all* electricity, from *all* sources, produced the same kind of chemical action. We will endeavor to show that this is perceptibly true only under certain conditions. The disruptive and the convective discharge from all high potential sources of electricity, such as the static machine, spark coils of all varieties, and high-frequency machines of all kinds when discharged in the air, will separate the oxygen, nitrogen, etc., and cause a shrinkage in the

volume of oxygen to form ozone, each molecule containing three atoms of oxygen instead of two, the ozone producing a very pungent, irritating odor. When a spark or convective discharge is thrown upon the surface of, or into, a liquid, it seems to have the same, or similar, chemical and electrolytic action as does a continuous current when the latter passes through a liquid; whether this is due to the action of the electricity upon the liquid, or whether it is due to the combination products of the air, plus the electricity, is a question which, in view of further facts to be stated, will be answered in favor of the latter proposition; for instance, if perfect contact is made with a liquid electrolyte (which may be done by placing in it the ends of wires coming from the positive and negative sides of a static machine, or other source of high potential electricity), and the current is allowed to pass through the liquid either as a silent discharge or as a disruptive discharge (*i.e.*, sparking between the sliding rods), there will be no perceptible chemical change in the liquid electrolyte.

As many of our therapeutic applications are made by surface contact, and as the body then becomes the electrolyte, we must, in such instances, eliminate any idea of a *perceptible* chemical change going on in the tissues,—at least any such chemical change as we would have reason to *know* would take place with a continuous current passing through the body electrolyte. Here, in proportion to the strength and density of the current and the length of time of application, there would be a definite and, under certain conditions, a perceptible chemie and electrolytic action; for instance, the difference in taste on the two sides of the mouth when a continuous current is passed through the cheeks. In the electrolytic action of the continuous current the molecules are broken up, each positive and negative ion assumes the osmotic function of a molecule, and increases the osmotic pressure of the electrolyte; positive ions are attracted to the negative pole, and negative ions are attracted to the positive pole. To an imperceptible extent this is doubtless true of static currents also. We know that the static current does produce slight chemie action, for electroplating has been done experimentally by this current, but the chemie action is so slight that it takes a long time to produce any perceptible effect.

CURRENTS OF LOW POTENTIAL.

It matters little in what form electricity is applied to the human body if we remember that the effect is primarily that of a stimulant, perhaps local, perhaps general, but in all probability both. Electricity in passing from one pole to the other through a compound electrolyte or conductor, such as is found in the human body, charges by conduction all conducting material outside of the immediate path of the current. To the fluids and salts of the body are we indebted for our principal conducting media; the muscles, nerves, and other subcutaneous tissue, whose cells are constantly bathed by the fluids, must, in a measure at least, owe their conductivity to these fluids; but even these subcutaneous tissues are highly conductive to the various currents of electricity as compared with the skin. So in all precutaneous applications we must remember that the dry skin offers so much resistance, especially to the passage of the continuous, the sinusoidal, and the faradaic currents (all currents of low potential), that, in order to pass sufficient current through it to affect the underlying structures, we must use pads of sponge, cotton, or some other soft absorbent material, well moistened in warm water, preferably containing a little salt, while remembering the law that the resistance of any substance is directly proportional to the length of the conductor and inversely proportional to the area of its cross section. Therefore, the skin being a poor conductor and offering great resistance, we must cover enough area to pass a current through of sufficient strength and without *burning* the skin, thereby avoiding ugly, painful blisters; this is most liable to happen when using the continuous current.

This current, as we have seen, was discovered by Galvani to be normal to the tissues, inasmuch as it is measurable by the same form of instrument and seen to follow the same law as the tissue currents. In another way the continuous current may be said to be normal to the tissues, for by the careful use of this current we may perceive when the motor nerve supply to a muscle through the spinal centre is complete, or whether there is a block in the continuity of the nerve from centre to periphery. It also tells us whether the muscular contractions are normal or abnormal, and we may approximately determine the degree of degeneration in a muscle and

nerve in proportion to the degree of their variation from a normal response to this current.

According to the law or natural formula of response as laid down by Pflüger, when an indifferent electrode is placed upon the chest or back, and a small motor point interrupting electrode is placed over a motor point and the current interrupted, the group of muscles supplied by that nerve should contract more quickly and with less current when the negative electrode is over the motor point and on the closure of the current than would be the case with kathode open contraction (K. O. C.), A. O. C., or A. C. C. This is known as kathode closure contraction, and is written, K. C. C. Pflüger's law is familiar enough to us all to warrant our proceeding without further explanation.

Why do these degenerate muscles and nerves refuse to respond in contraction to the normal K. C. C. and respond to A. C. C.? I have never heard of any reason to explain this phenomenon except the one advanced by the writer before the Medical Society of the District of Columbia some years ago. This reason, of course, is mere speculation, and it will be repeated here only with the hope that it may lead to some discussion, adverse or otherwise, and in that way bring out the views of those more competent to give exact and reliable information, which alone can conduce to more perfect therapeutic knowledge.

As bearing upon the subject, we will now return to the experiments of Mateuci, Du Bois Reymond, Brown-Séquard and others, who have shown that the nerves, muscles, and other tissues of the body have electrical currents of rest, also of action, and that the strength of these currents is directly proportional to the vitality of the tissues. The currents of rest in the tissues, as I conceive them, are currents of potential energy stored in the tissues through and by the pressure of friction, if you please, of the fluids of the body in which they are constantly bathed. When a normal muscle is made to contract by a volitional nervous impulse, or by any other cause, the potential energy stored in the nerve centres and muscles is converted into kinetic energy. A current of positive variation passes down the nerve and muscle in contraction, and a current of negative variation passes up the contracting muscle and excited nerve. The currents of variation are here spoken of in the physiological sense;

the positive variation passing along the excited nerve from centre to muscle and along the course of the contracting muscle, thereby intensifying the action of muscle and nerve. The negative variation passes up and against the source of energy with an impeding influence.

When a muscle is cut off from its nutrient centre in the anterior horns of the spinal cord, both the muscle and nerve supplying it waste away and are incapable of action. Bathed in the alkaline fluids, the normal positive variation changes, and the whole muscle and nerve gradually become negative and consequently irresponsive to the negative polar action, for, receiving no aid from its centre and normal positive current of variation, responses to the anode closure contraction are slow and sluggish. This would seem to suggest that muscle and nerve responses to the continuous current are due, in a measure at least, to chemical action, as the alkaline negative pole can elicit no response in a muscle that has become largely alkaline in reaction by degeneration; but the positive pole, having the function of attracting to itself the acid remaining in the muscle, will cause contraction until degeneration is complete, when even the positive pole will fail to cause it.

The important question arises, how long can a muscle and nerve remain in complete degeneration without giving any response to the continuous current of either polarity and still in time regenerate? Some say six months, others say one year. In these cases eternal vigilance is the price of knowledge.

I have under my care at the present time a child who three and a half years ago had an attack of poliomyelitis involving the anterior horns of the lumbar cord, producing a paraplegia. I have been working on him nearly three years, and, while I have kept the nutrition of the muscles in a fairly good condition, only within the last three months have I seen any sign of returning reaction; first A. C. C., but now, in some of the muscles, K. C. C. is obtained. How much the little fellow will improve I am unable to say, but with return of contraction comes a ray of hope.

The formula for the normal contractions to the continuous interrupted current is as follows: First, and with the least current, kathode closure contraction, K. C. C.; next with a little stronger current, anode closure contraction, A. C. C.; with stronger currents

comes anode open contraction, A. O. C., and with still stronger currents we will get kathode open contraction, K. O. C.

In practice it is unnecessary to bother about A. O. C. and K. O. C. when we are testing degenerate nerve and muscles, as any reverse deviation from the normal K. C. C., even when K. C. C. and A. C. C. are equal, will indicate degeneracy in that particular nerve. The degeneration will be in proportion to the degree of reverse variation from the normal formula. The contractile response of the muscle to the faradaic current is either altogether suspended or very feeble.

How do these two currents act in producing muscular contractions? It has been frequently stated, for want of a better explanation, that the galvanic current acts directly upon the nerve and muscle protoplasm. This is undoubtedly true; but, when the protoplasm of nerve and muscle is cut off from its centre of nutrition, and is no longer able to respond to the normal K. C. C. or any other form of stimulus, except to the A. C. C., one at least would have a right to think, in view of the evidence adduced, that, in the absence of activity of the normal muscle and nerve currents in the tissue, their ability to carry on their normal ionic changes and exchanges is in a measure substituted for by the galvanic current, and that the normal, quick, and vigorous contraction of muscle under the influence of the closing contact of the negative side of the continuous current is merely an irritation and intensification of the normal nerve and muscle current, which, after all, *may* be the instigator and starter of a nerve impulse.

The faradaic stimulation of muscle to contraction, there is reason to believe, is in a measure a reflex stimulation, since a block in the anterior horn of the spinal cord or motor nerve will inhibit its action; but, when the path is open, very powerful contractions are produced. This in a less degree seems to apply to the galvanic current when very rapidly interrupted,—*i.e.*, up to eight or ten thousand times a minute. These currents of rapid interruption seem to act more directly upon the sensory nerves, and to transmit their impressions through the reflex arc in the spinal cord, causing, when long continued, a summation effect and fatigue; hence rapidly-interrupted currents, either faradaic, galvanic, or alternating, should be used with care, and for short periods only, when we are treating degenerate nerve and muscle.

It is a physiological fact that the lost proteid material in a wasted degenerate muscle can be restored only by exercise; that exercise must be of such a nature as to give tone and produce no fatigue; in order to secure this, we must, as far as we are able, supplement nature by slow anode closure contractions until the normal K. C. C. returns, then cautiously aid action of the reflex arc by gentle and short applications of the faradaic current, preferably, at first, of the slower and coarser interruptions. When the degenerate nerves and muscles refuse to react to the normal K. C. C. it seems a waste of time to massage these muscles, as they are incapable of responding by the liberation of their normal electrical currents, and when massage is used to the exclusion of the galvanic currents (which in itself furnishes the artificial nutrition of the normal animal currents) it is worse than useless.

We have seen that in degenerate, paralyzed muscles we have an alkaline condition of the motor nerves and muscles, and that the negative ions preponderate. It has been shown by Professor Bose that the negative condition is one of exhaustion and decay. Pauli has demonstrated that the negative ions produce irritation; therefore, not only in a degenerate *motor* nerve and muscle do we expect to find the negative ions preponderating, but in an excited, irritable, and painful sensory nerve as well. Here the application over and as near to the painful nerve as possible of a mild galvanic current of the positive sign will tend to neutralize the negative ions by attracting the acid and oxygen of the tissues to the affected area, and so help to restore a healthy normal condition and relieve pain.

When we wish to irritate a part, we use the negative; when we wish to soothe, we apply the positive.

Again, experience has proven that a current flowing along the course of a motor nerve will increase the nerve impulse, hence the contractile power of the muscles. A good way to improve the general metabolism and nutrition of all the tissues supplied by the spinal system of motor nerves is to place the hands in two basins of slightly salted warm water together with the negative poles of a galvanic battery (this may be done by using two cords on the negative contact of the battery). The positive pad electrode, about the size of the hand, may be rubbed slowly and firmly over the cervical and dorsal vertebræ while a current of from ten to fifteen milliamperes is flowing.

With ten milliamperes flowing the current may be occasionally interrupted, which will increase markedly the intensity of the stimulus. The same process may be carried out with the lower extremities by placing the feet in a basin together with the negative electrode, while the positive is applied to the lower dorsal, the lumbar, and sacral regions. In like manner if we wish to stimulate any special set of organs, such as the liver, the stomach, or intestines, we may do so by placing the positive electrode over the second and third lumbar vertebræ, according to Abrams's method, and place a large negative electrode over the organs that we wish to treat, pressing firmly down, and using current enough to cause gentle contraction when the current is interrupted.

The stimulating effect of the continuous current is readily seen upon the vagus in cases of exophthalmic goitre, where the tumultuous action of the heart is so great sometimes as to shake the entire body of the patient with each ventricular contraction. Here the sympathetic is already overstimulated, and we need have no fear in applying small negative electrodes over each vagus, with the positive pad back of the neck; then, by turning on gradually fifteen or twenty milliamperes and holding the electrodes in place, the heart quiets down under the stimulating influence of the current upon the cardio-inhibitory fibres of the vagus nerve.

The pneumogastric nerve enjoys the widest range of distribution of any nerve in the body. When we stimulate the pneumogastric we slow the action of the heart, tone the muscular activity of the stomach, induce peristaltic action in the small intestines and increase the respiratory range. This nerve is also believed to have some controlling influence over the pancreatic secretions and the glycogenic functions of the liver.

The gentle stimulation of the pneumogastrics by the continuous current has for a great many years been a favorite treatment in stimulating general metabolism. It has been superseded by many modern inventions of currents of higher intensity, but I have grave doubts that its field of usefulness has ever been successfully filled by any other method.

A careful study of the direct or continuous current will fully repay anyone interested in electrotherapeutics, because:

It is a current of direction.

It is a current of decided and opposite chemical action at the two poles.

It is a current subject to many modifications of application and therapeutic value.

It is a current whose flow from a portable battery is just as efficient as, if not more so than, the current from the most elaborate wall cabinet.

It is a current normal to the animal tissue.

It is a current whose electrolytic law is fixed and definite.

Upon the latter law is based the zinc-mercury cataphoresis of Dr. G. Betton Massey, of Philadelphia, for the treatment of cancer and other malignant growths. This operation is now called by Dr. Massey "Ionic Surgery." Zinc needles varying in size to suit the case are amalgamated with metallic mercury, and, in such numbers as may be needed, are plunged into the tissues in the outer zone of the malignant growth. These needles are attached by small wires to the positive pole of a good battery, capable of a pressure of at least sixty volts. The negative dispersing electrode is of clay, sufficiently large to accommodate the current required. It is spread over the back or abdomen and attached to the negative side of the battery. A good smoothly working rheostat, designed by Dr. Massey, and a good accurate milliamperemeter, are placed in circuit. The patient being etherized, the current is turned on gradually to one hundred, five hundred, one thousand or fifteen hundred milliamperes, or more, according to the requirements of the case, and is allowed to flow through the tissues for a half-hour, one hour, or more if necessary, until the malignant growth has been destroyed by the current and the outlying sound tissues have been impregnated with ions of oxychloride of zinc and mercury, which seems to have the power of destroying any cancer cells outside of the immediate zone of operation.

This is the principle of the process. Anyone interested in ionic surgery will feel well repaid if he reads one or all of Dr. Massey's works upon this and allied subjects.

When a continuous current is flowing through the tissues the

chemical and electrolytic effect is directly proportional to the strength, the current, and density and time of current flow.

In the case of the zinc-mercury cataphoreses of Dr. Massey the electrolytic action of the current upon the zinc and mercury (the body fluids being the electrolyte) drives the electronegative metallic radicals of zinc and mercury into the tissues, seeking the negative pole; while the electropositive ions of acids and oxygen seek the positive pole, producing in the combination the oxychloride of zinc and mercury.

The electrolytic action of the continuous current has been utilized for many years for the purpose of destroying accessible tumors of the uterus, as well as small growths, such as moles, warts, etc. In these cases the negative pole is used as the active destructive pole. A very useful office is the possibility of causing the absorption of inflammatory adhesions in the female pelvis. Here the solvent properties of the alkaline negative pole are utilized, this pole being placed as near the lesion as is possible, with the positive pole over the back or over the abdomen. A current entirely tolerable to the patient is allowed to pass for a half-hour to an hour, two or three times a week, until the adhesions are dissolved, which will sometimes happen in three months.

When a current is flowing through the tissues and the circuit is broken and made, we increase the impulse of the current throughout the circuit, and all tissues within the circuit are made to contract in proportion to the intensity of the current. The stimulating effect is thereby markedly increased, and, if long continued, will produce a condition of fatigue in the muscular and glandular organs.

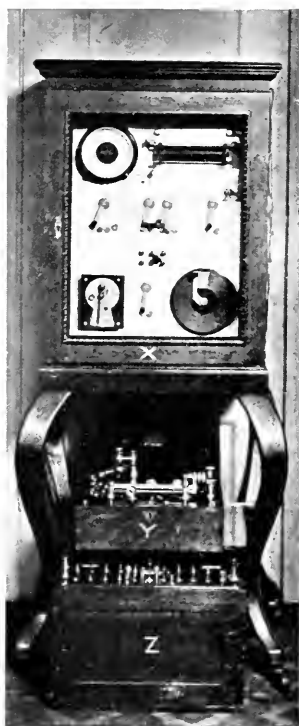
An apparatus that will interrupt the continuous current from eight thousand to ten thousand eight hundred times a minute was made by the writer, ten years ago, for experimental purposes and has since been found to be of great therapeutic value. It consists of a hard-rubber wheel with six poles mounted upon the shaft of a motor, revolving, at its highest speed, at the rate of eighteen hundred times a minute, giving ten thousand eight hundred interruptions per minute with this current. The author has duplicated the experiments of Dr. Le Duc in producing electric sleep in rabbits, and to a moderate degree electric anæsthesia. But the greatest benefit from this current has been found to be in overstimulation and electrolytic action

FIG. 1.



Rapidly interrupting galvanic current (10,800 times per minute). A patient with fibrous goitre is undergoing treatment.

FIG. 2



X, Galvanic and faradaic wall case; Y, portable faradaic battery; Z, portable galvanic battery.

upon hyperplastic glands, such as fibroid goitre, enlarged spleen and liver, and a surging *mild* application for atonic conditions of the abdominal and pelvic viscera.

Fig. 1 shows this apparatus in circuit with milliampèremeter, voltmeter, and rheostat. By using the lever handle of my voltmeter I can run my current from zero to the full capacity of the apparatus, or any modification of the capacity, giving a surging current. This current in steady full force is undoubtedly the ideal current for the treatment of hypertrophy of the prostate gland, when the negative pole can be held firmly in position; this pole being an olive tip of brass, No. 40, of the French urethral scale, flattened on one side and lacquered on the round side to insulate it from all tissues except the prostate. The gland may be held, as it were, in a vise, and the life practically squeezed out of it. When there is no malignant complication, atrophy follows frequent and long-continued application.

To mention all the advantages and uses of the direct current and its modifications would fill a good-sized book, and after stating that the tonic effect of short and mild surging treatments for the cure of relaxed vaginal walls and uterine ligaments is most beneficial when used every day or not less frequently than every other day, I will describe the use of the

SINUSOIDAL CURRENT

This is a current whose polarity constantly changes at regular periods, smoothly and evenly in a sine curve, above and below the zero line, as shown in Dr. M. H. Brinkmann's valuable paper (INTERNATIONAL CLINICS, vol. i, 23d series). With a good apparatus one may get rapid and slow reversals at will, with the ampèrage and voltage accurately measured, and when we consider that the metabolism of the tissues is a series of rapidly-changing positive and negative currents or signs, known as anabolism and catabolism, we should not be surprised to find this current most valuable in stimulating and increasing the nutritive processes of the body.

Dr. Albert Abrams, in his recent volume on "Progressive Spondylotherapy" (San Francisco, 1913), gives most explicit directions for its use through certain nerve segments of the spinal cord. The writer has recognized for a great many years the value of treat-

ing through the spinal nerve centres, and, since the publication of Dr. Abrams's work, has followed very closely the directions there laid down, with good results in some cases, but he feels free to confess that (perhaps through his own ineptitude) he has been unable to duplicate the wonderful results obtained by Dr. Abrams.

Every change from one polarity to the other materially augments the electric impulse of the tissues, and when the object is to exercise the muscles and produce tissue gymnastics in localized areas the current is of wonderful advantage and of late years has been very popular. The slow, regular alternations have a decidedly tonic effect and have the advantage of being more penetrating and more regular in action than the alternating effect of the slowly-interrupted induced or faradaic currents.

Induced or Faradaic Currents.—The effect of these currents seems to be largely due to their irritating action upon the peripheral sensory nerves through the reflex arc in the cord to the spinal motor centres, and through them to the muscles. This fact appears to be true of the induced current of all frequencies.

One of the early signs of muscular and nerve degeneration is manifest when the muscles refuse to contract, either to the stimulation of their motor points or of the muscles themselves, on the application of the induced current. Though somewhat inconvenient to use, this is one of the best currents that we possess for the stimulation of metabolism. Here the patient sits with his feet in a tub of warm water, with the negative pole in the water with the feet. If an interrupting electrode handle is used, with small electrode well moistened, each group of muscles may be made to contract, one after the other, and as this is done through the reflex centres it is easy to see how far-reaching is the action of this current. Either the rapid or slow interruptions may be used in this way; if the former, the muscles may be held in contraction and released at will. This is often an advantage.

The primary circuit of the induced current is pulsatory in character, and, in the presence and light of the other currents mentioned, offers no special advantage, except that it produces the electromagnetic field that induces the current in the secondary coil. The advantage of the galvanic and faradaic batteries is that they are perfectly reliable in a portable form, and for that reason, when correctly applied,

may do good service at the bedside, and in the country when it is impossible to get the larger and more cumbersome outfit such as is used in the laboratory of the specialist.

The average faradaic current batteries sold in the shops are mere toys, and the writer's advice to one contemplating the purchase of a battery is to select one of reliable make. It is not within the province of this paper to mention names of manufacturers, but any reliable electrotherapist will, I am sure, willingly furnish information upon this subject.

Fig. 2 (*X*, *Y*, *Z*) represents the form of portable galvanic and faradaic batteries, as well as the stationary battery used by the writer.

Before beginning the therapeutic application by physical methods it may be well to state that every office, operating room, or physical laboratory should have a well-equipped clinical laboratory, so that there may be an accurate record (without too much expense to the patient of moderate means) of the condition of the patient when he begins treatment, and of the progress of the metabolic processes as the treatment progresses.

Careful and repeated physical examinations are conducive to accurate diagnosis, which, with a knowledge of the pathology of the disease or condition under consideration and a thorough knowledge of the physical and physiological properties of the remedial agent to be employed, not only leads to intelligent treatment of the case, but assists us to a more accurate and rational prognosis.

The motor points should be carefully studied; these will be found in most up-to-date treatises on nervous diseases and in many of the best works on physiology.

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